

The potential for GB-European trade in liquid milk

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We would also like to acknowledge the help and guidance we have had from Defra during the course of this research.

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S1. Executive Summary

S1.1. Background

Following the formation of the Single European Market in 1992, all duties, tariffs and quotas on trade within the Community were abolished. This resulted in the elimination of significant cost increasing *formal* intra-EU barriers to trade, facilitating the free movement of capital, labour, goods and services between Member States; transaction costs (i.e. transport and marketing costs) associated with intra-EU trade were reduced thereby increasing the possibility of exploiting *arbitrage* opportunities in the EU.

It would therefore have been expected that in the light of the introduction of the Single European Market and the implementation of common EC rules on milk hygiene in 1994, intra-EU trade in liquid milk, as in other product areas, would have been encouraged. In practice, however, even though there has subsequently been some growth in intra-EU trade of liquid milk (particularly long-life milk) between other EU Member States, trade between the United Kingdom and mainland Europe (and between Great Britain and Ireland) has been minimal, suggesting that significant barriers or impediments to trade still exist. Consequently, the liquid milk market in Great Britain tends to be regarded as national at its widest.

S1.2. Aims and objectives

The aim of this research is to assess the potential for trade in liquid cow's milk (raw, pasteurised, UHT and organic) between Great Britain and mainland Europe. Specifically, it examines the various *informal* barriers and risks to trade in liquid milk between Great Britain and mainland Europe (including Ireland) and identifies the sets of circumstances under which we would expect to see potentially substantial exports of liquid milk from Great Britain or imports of liquid milk into Great Britain. Accordingly, the detailed requirements of this research are to:

1. identify, and where possible, quantify and rank the various barriers to trade between Great Britain and other countries;
2. assess how these barriers have altered over time and how they may change over the next decade or so in relation to demand and supply side developments;
3. specify under what circumstances export of liquid milk from Great Britain to other EU member states would become feasible;
4. specify under what circumstances import of liquid milk from other EU Member States to the UK would become feasible; and,
5. consider to what extent potential competition from continental suppliers constrains the pricing behaviour of Great Britain liquid milk processors.

S1.3. Conceptual overview

Economic theory purports that the presence of arbitrage opportunities equalises prices between markets. The basic economic analysis of trade relies on the *spatial equilibrium* concept, which suggests that related markets will interact through trade towards an equilibrium or balance between supplies and demands in different locations, thereby equalising prices. The proposition that the presence of arbitrage opportunities tends to equalise prices is known as the *law of one price*.

Any deviation from the *law of one price* is a measure of the degree to which barriers to trade between markets exist (i.e. the extent to which arbitrage between markets is impeded). Since there are no longer any *formal* intra-EU trade barriers within the Community, any deviation from the *law of one price* between markets will be attributable to *informal* trade barriers. The geographical separation of markets often prevents price equalisation from taking place due to differences in the size of transport and transaction costs between locations; distance is positively correlated to transportation costs (which may cause price variations in the price of tradable inputs) and the further apart two locations are, the higher the probability that there are different cost and technological structures between locations.

S1.4. Informal barriers to trade

S1.4.1. Transport costs

In explaining why relatively little trade in liquid milk takes place between Great Britain and other European Member States, the cost of transport is frequently cited as forming one of the main barriers. This is primarily because milk is typically a bulky, perishable and low value product, relative to the cost of transport. Although the underlying costs of transport have increased over the period, the dairy sector has been able to capitalise on significant operational efficiencies which have to some extent mitigated these cost increases, thereby facilitating increased trade both within Great Britain and between Great Britain and particular European Member States. Looking forward, there is concern that increased congestion on Britain's roads and at ports will extend journey times resulting in increased transport costs, thereby reducing the potential for GB-European trade in liquid milk.

S1.4.2. Economies of scale

The British liquid milk processing sector operates some of the newest and most efficient dairies in Europe. This provides British liquid milk processors with a significant cost advantage *vis-à-vis* other European fresh liquid milk processors, particularly given that fresh liquid milk in many European countries tends to be more of a niche product, and therefore produced in smaller scale dairies. The converse is, however, true in British UHT milk processing capacity. Britain generally lacks the economies of scale and efficiency in UHT milk processing to compete with its European counterparts.

S1.4.3. Consumer preference

The British liquid milk market is to some extent protected by imports by virtue of its strong preference for **fresh pasteurised milk**, and the converse is true for exports to mainland Europe, where **UHT** milk is preferred.

The **perishable nature** of fresh liquid milk has traditionally formed a significant impediment to trade. However, over the last 20 years the shelf life of fresh liquid milk has doubled from 5-6 days to around 11 days, thereby facilitating the increasing distances which liquid milk is transported within Britain. Furthermore, the application of micro filtration technology has led to the introduction of a new extended shelf life milk. These filtered milks typically have an extended shelf life of around 20 days, double that of conventional fresh liquid milk. Filtered milks accounted for some 4% of total milk sales in 2006.

The British liquid milk and dairy market is increasingly being differentiated by **provenance** of raw milk production, thereby requiring the procurement of raw milk from distinct national and regional milk fields. Current and planned initiatives to brand milk on a more local basis, primarily by the multiple retail segment, will increase the level of differentiation further. This has created a very substantial barrier to entry for raw milk supplies outside these national and regional milk fields, as well as for the import of liquid (raw or processed) milk into Great Britain from other European countries.

S1.4.4. Access to distribution channels/markets

Despite the declining role of the **doorstep delivery system**, this distribution channel still forms a significant barrier to entry. Any foreign liquid milk processor looking to export fresh processed milk to the British market would need to trade with a bottled milk buyer (i.e. independent milkman) or establish its own doorstep customer base.

In recent years the **multiple retail sector** has been developing a strong commitment to British agriculture. As such, the sector has increasingly been seeking to source British products, where they are available. This requirement imposes an enormous barrier to imports of liquid milk, even if a European based milk processor could meet retailers' stringent service requirements concerning daily and timely supply of appropriate volumes of liquid milk, at the right quality and service level direct to their stores.

Due to the seasonal nature of UHT production in many neighbouring Member States, multiple retailers' stringent requirements for a constant shelf life period all year round impose a considerable barrier to imports of UHT milk for this retail outlet. In the organic sector, the imposition of standards by some certification bodies in excess of the minimum laid down in EC Regulation 2092/91 on organic production (as amended by EC Regulation 1804/99) effectively limits imports of organic milk to those neighbouring countries where production meets these additional standards (e.g. Belgium, Denmark, Germany and the Netherlands).

Middle ground customers generally impose less demanding standards in relation to the quality of milk procured than the national multiple retail sector. These less exacting standards create lower barriers to entry than to the multiple retail segment.

S1.5. Potential for GB-European trade in liquid milk

Given that liquid milk is a bulky and typically low value product, the cost of transporting liquid milk across Britain's maritime border to neighbouring EU Member States, and typically its perishable nature, form significant barriers to trade. For trade to be viable, the difference between the price of liquid milk in two markets must be greater than the transfer costs (i.e. transportation and transaction costs), which are a product of the *informal* barriers to trade.

As would be expected *a priori*, the cost of transporting fresh processed milk across Britain's maritime border to neighbouring EU Member States (from a distance of 45 miles either side of the port/terminal) increases with distance. For raw liquid milk, transport costs range from 1.7ppl to France to 4.9ppl to Denmark. The cost of transport to Belgium, the Netherlands and Ireland was similar, ranging from 3.0ppl to 3.5ppl.

As less packaged milk is transported in a refrigerated trailer compared with a bulk milk tank trailer, the cost of transporting packaged milk is significantly greater. For packaged processed liquid milk, transport costs range from 5.1ppl to France to 14.5ppl to Denmark. The cost of transport to Belgium, the Netherlands and Ireland was similar, ranging from 9.0ppl to 10.4ppl.

Nevertheless, for some products under certain conditions there is evidence of limited trade in both raw and processed milk between Great Britain and other European Member States. Historically, raw milk exports have occurred as a balancing activity during periods of excess milk supply relative to processing capacity. These exports take place at marginal cost and as such are generally not considered to be a commercially viable option over the medium term.

Similarly for imports, the national imbalance in the current supply and demand of organic milk has resulted in the need to import raw organic milk as a short term balancing activity. It is expected that organic raw milk imports during 2006/07 will reach 7 million litres (2% of UK raw organic milk production) rising to 20 million tonnes in 2007/08 (5% of UK raw organic milk production).

For processed liquid milk, the medium to long term potential for trade is relatively more sustainable. Although UHT milk is regularly imported into Great Britain for sale predominantly by the discount retail sector, stringent supplier requirements imposed by the multiple retail sector, as noted above, are likely to limit the potential to increase UHT milk imports further, despite the operational cost disadvantages of British UHT milk processors. Given the importance the discount retail sector places on price this overall effect will tend to be offset to a degree if exchange rate movements are such as to favour imports.

In recent years, a number of British based dairy companies have been exporting processed liquid milk, primarily to Spain (and its Islands) targeting the growing British ex-pat community and tourist sector. Milk Link is exporting UHT milk (*Scottish Pride* long life milk and long life *Moo* milk) to Malta (with a 25% share of the market) and Spain (including the Canary Islands).

Significantly, recent development in filtered extended shelf life fresh milks has resulted in both Arla Foods UK's *Cravendale* and Wiseman Dairies' *Puriti* brands being exported in packaged form to Spain (including its Islands) where there is a high demand for fresh processed milk among the British ex-pat community and tourist sector, which traditionally has not been met. The extended shelf life of 20 days, double that of conventional fresh pasteurised liquid milk, and the premium price consumers are prepared to pay for 'fresh' milk has made trade viable. More importantly in the context of this research, this growing trade may have significant implications for the definition of the fresh liquid milk market as applied by competition authorities when assessing horizontal mergers within the industry. The competition authorities currently have no evidence to believe that imports and exports of raw milk and fresh liquid milk into and out of Great Britain take place in significant quantities. However, this study found no evidence to suggest that imports of significant and sustainable volumes of fresh liquid milk take place. It is the competition authorities view that the issue of imports into Great Britain may be more relevant than the issue of exports from Great Britain when defining the fresh liquid milk market.

S1.6. Market integration and implications for competition policy

S1.6.1. Market integration - long run transmission of prices

The results of our econometric modelling suggest that the UK (British) raw milk market is relatively well integrated with the neighbouring EU Member States (trade partners) considered in this analysis. The *Bayesian Monte Carlo Markov Chain* approach used to assess market integration and price transmission produces results which suggest that each of the five EU Member States (partner markets) considered have influenced prices in the UK (British) raw milk market over the period 2000 to 2006 through the transmission of long-run price signals. This suggests a wider degree of market integration than might have been expected *a priori*.

Specifically, the results suggest that for the UK/Denmark, UK/Netherlands and UK/Germany price pairs, evidence of a long-run equilibrium, in both directions, between spatially separated market prices was found. Furthermore, the Bayesian model selection procedure supports the contention that both French and Irish prices influence UK liquid milk prices in the long-run, but that no long-run causality flows in the opposite direction. It would appear, therefore, that the UK does not have a long-run causal influence on either French or Irish prices.

The extent to which actual or potential trade in liquid milk is responsible for this market integration is difficult to quantify given the aforementioned trade data limitations. However, there are several

marketing channels by which prices can be equalised between markets, thereby establishing a chain of inter-related prices for the same (commodity) product at different geographic locations and at different stages in the marketing chain for raw, processed and commodity products.

One possible explanation for this unidirectional transmission of prices from both France and Ireland to the UK is the relative increased importance that the highly tradable commodity markets play in setting milk prices in these countries. It is well documented that commodity products (such as butter, powder and certain cheeses) set the floor price to the market, and the homogenous nature of most liquid milk means that average producer milk prices are driven by price movements in commodity markets. In France and Ireland, the feed through from these commodity markets may be faster given that a producer price index system operates in France (directly tracking movements in butter, milk powder and whey) and that the vast majority of Irish dairy production is in the form of commodity products.

S1.6.2. Market integration - short run transmission of prices

The model results also suggest that, where long-run bi-directional causality is supported, short-run transmission of price shocks between markets appears relatively subdued, although in the French and Irish markets short-run price shocks were transmitted much faster. These milk markets are geographically closer to the UK market than those of Denmark, Netherlands and Germany. Accordingly, economic theory suggests that price equalisation (the *law of one price*) is more likely to take place in such markets due to relatively lower transport and transaction costs and the resultant increased opportunities for arbitrage.

S1.6.3. Implications for competition policy

These results therefore suggest that in terms of competition there is significant evidence that the UK (and British) liquid milk market cannot be treated as an isolated and insulated market, although each competition inquiry will review the issues on their own merits. There is clear statistical evidence that the UK (British) raw milk market is relatively well integrated with other EU Member States, despite the fact that there is relatively little trade in liquid milk.

I. Introduction

I.1. Background

A priori, it would have been expected that following the formation of the Single European Market in 1992 and the implementation of common EC rules on milk hygiene in 1994, intra-EU trade in liquid cow's milk¹, as in other product areas, would have been encouraged. Although subsequently there has been some growth in intra-EU trade of liquid milk (particularly long-life milk) between other EU Member States, trade between the United Kingdom (UK) and mainland Europe (and between Great Britain and Ireland) has been minimal, suggesting that significant *informal* barriers to trade still exist. Consequently, the liquid milk market in Great Britain tends to be regarded as national at its widest. Amongst other things, this has implications for the way competition authorities consider proposed mergers.

I.2. Aims and objectives

The aim of this research is to assess the potential for trade in liquid cow's milk (raw, pasteurised, UHT and organic) between Great Britain and mainland Europe. Specifically, it examines the various economic, logistical, structural and technological barriers and risks to trade in liquid milk between Great Britain and mainland Europe (including Ireland) and identifies the sets of circumstances under which we would expect to see potentially substantial exports of liquid milk from Great Britain or imports of liquid milk into Great Britain.

Accordingly, the detailed requirements of this research are to:

1. identify, and where possible, quantify and rank the various barriers to trade between Great Britain and other countries;
2. assess how these barriers have altered over time and how they may change over the next decade or so in relation to demand and supply side developments;
3. specify under what circumstances export of liquid milk from Great Britain to other EU member states would become feasible;
4. specify under what circumstances import of liquid milk from other EU Member States to the UK would become feasible; and,
5. consider to what extent potential competition from continental suppliers constrains the pricing behaviour of Great Britain liquid milk processors.

I.3. Methodology

Our methodological approach to this research consisted of a combination of a review of the relevant academic and industry literature and economic and econometric analysis, supplemented by semi-

¹ Hereafter referred to as 'liquid milk'.

structured interviews with key industry stakeholders (liquid milk buyers, liquid milk processors, dairy product manufacturers, milk hauliers, multiple retailers and stakeholder organisations) in both Great Britain and selected EU Member States.

I.4. Report structure

In Section 2, a contextual overview of the liquid milk market in Great Britain/the UK is presented, introducing the industry specific issues and policy background pertinent to this research assessing the potential for trade in liquid milk.

The barriers and impediments to trade in liquid milk between Great Britain and other EU Member States are then presented in Section 3. A desk based review of the relevant academic and industry literature, supplemented by semi-structured interviews with a selection of industry stakeholders in Great Britain (as well as mainland Europe), was carried out to identify these barriers. An account of how these barriers have changed over time, as well as an assessment of their importance to the sector as impediments to both imports and exports of liquid milk, is also presented.

An assessment of the market conditions under which trade in liquid milk between Great Britain and other EU Member States would likely be feasible is presented in Section 4. In particular, this Section also presents evidence of recent trade patterns for liquid milk in both raw and processed form as well as bulk and packaged form, based primarily on evidence from the stakeholder interviews.

The extent to which potential competition from continental suppliers constrains the pricing behaviour of British liquid milk processors is addressed in Section 5. Results using Bayesian econometric time series analysis of price transmission between producer prices for raw milk in the UK and five neighbouring EU Member States are presented; a number of conclusions are made concerning the degree to which the British raw milk market can be considered isolated from the raw milk market of neighbouring EU Member States and its implication for the issue of market definition and competition is discussed.

2. Overview of the UK/GB liquid milk market

2.1. Introduction

This Section provides a contextual overview of the liquid milk market in Great Britain/the UK, by introducing the industry specific and policy background pertinent to this research. Background on the production and consumption of liquid milk is initially presented in Section 2.2, highlighting the importance of the liquid milk market within the overall UK dairy market. An evolutionary account of the changes in the supply chain dynamics for liquid milk over recent years is presented and the implications for the liquid milk sector are discussed (Section 2.3). In this context, the trade position of the sector is analysed (Section 2.4) noting in particular developments over the period in both the volume and value of trade in liquid milk. In Section 2.5, the concept of 'market definition' and the implications for industry consolidation are discussed in the context of this research.

2.2. Production and consumption

The production of raw milk in the UK delivered to the milk and dairy processing sector is around 14 billion litres per year. In 2005/06, 13.6 billion litres² was delivered to UK dairies, of which just over half (51%) was processed for the consumption of liquid milk. The remainder was manufactured into dairy products such as cheeses (28%), condensed milk and powders (12%), butter (2%), cream (2%) and yoghurt (2%) (Figure 2.1).

This dominant utilisation for the liquid milk market signifies the importance of the liquid milk sector within the overall UK dairy market. In the organic sector, the importance of the liquid milk market in terms of milk supply is even greater, utilising almost two-thirds (64%) of organic milk deliveries in 2005/06 (OMSCo, 2007).

Furthermore, this dominant utilisation of raw milk for liquid consumption is exceptional compared with utilisation in neighbouring European countries, where the proportion processed into liquid milk varies from a high of 24% in Germany to a low of 9% in Denmark (Table 2.1).

Table 2.1: Utilisation of raw milk for liquid milk in selected EU Member States, 2002

	% utilisation
Denmark	9
Netherlands	14
France	15
Germany	24
UK	49

Source: KPMG based on ZMP 2002 and other sources

² Unadjusted for butterfat

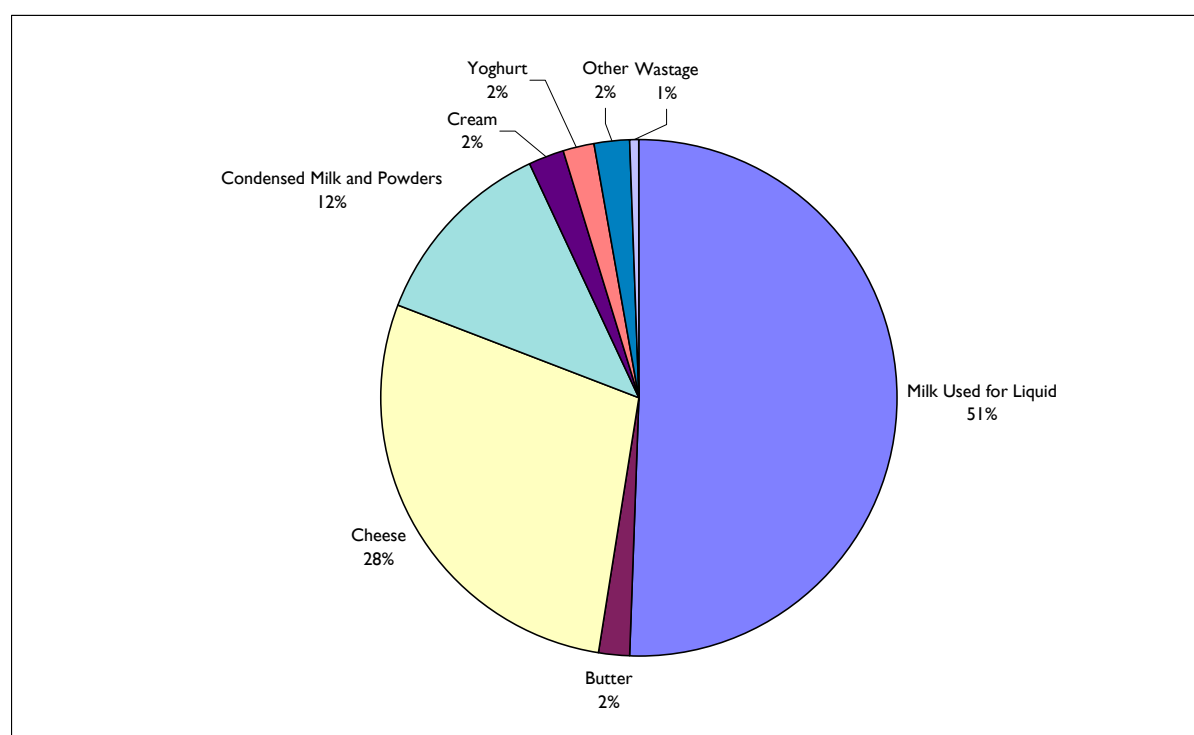


Figure 2.1: Utilisation of raw milk by UK dairies, 2005/6

Source: MDC datum, Defra

Consumption of liquid milk in Great Britain is one of the highest in the EU, but has shown a steady decline over the last three decades, although recent data may suggest that this decline has been arrested (Table 3.3, Section 3.5). Most liquid milk in Great Britain is consumed in fresh pasteurised (which includes organic and channel island) form (88%), but a small proportion is UHT long-life milk (8%) (Table 2.2).

Table 2.2: Retail and doorstep sales of liquid milk in Great Britain, by type

	2002		2006		% change 2002-2006
	million litres	%	million litres	%	
Pasteurised conventional	4,052.3	87%	4,056.8	85%	0.1%
Pasteurised organic	42.8	1%	150.6	3%	252.3%
UHT	353.7	8%	368.4	8%	4.2%
Other	187.1	4%	184.5	4%	-1.4%
Total	4,635.8	100%	4,760.3	100%	2.7%

Source: TNS

The relative stability in demand for pasteurised and UHT milk in recent years masks some important changes that have occurred between different liquid milk categories. In the organic sector, there has been a considerable increase in the demand for fresh organic liquid milk. Between 2002 and 2006, sales have increased from 42.8 million litres to 150.6 million litres, increasing its market share of the total liquid milk from 1% to 3%, at the expense of sales of fresh conventional liquid milk (Table 2.2).

There has also been a steady increase in sales of differentiated and branded fresh (both conventional and organic) and UHT liquid milks³. Probably the most important of these, in the context of this study, is the development of extended shelf life fresh milk, often referred to as filtered milk (Section 3.4.2). These include Arla Foods' *Cravendale* which was launched regionally in 1998 and nationally in 2002, Tesco's *Pure Milk* which is produced by Wiseman Dairies and launched in 2005 and more recently Wiseman Dairies' *Puriti*, launched in 2006. Demand for such filtered extended shelf life fresh milks has increased steadily since their launch (Figure 2.2), with sales accounting for around 4% of the total liquid milk market in 2006 (Murden, 2006).

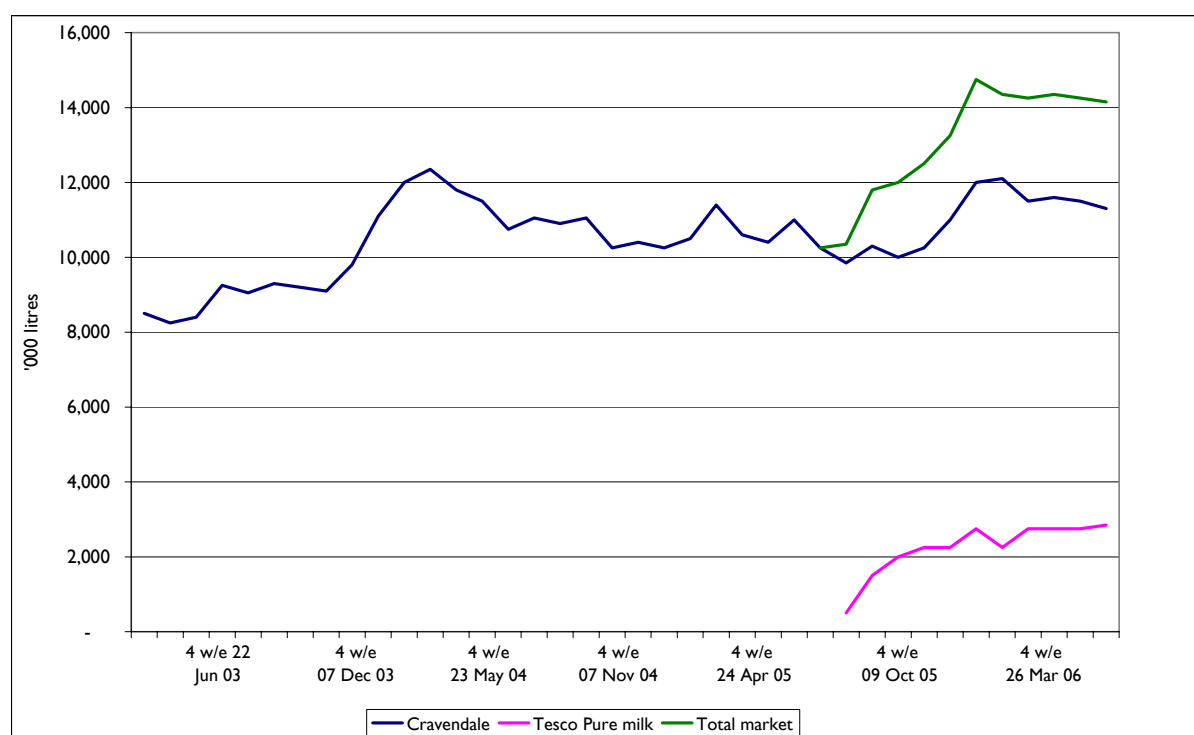


Figure 2.2: Filtered extended life milk sales, by brand

Source: TNS

2.3. Supply chain dynamics

The retail liquid milk market in Great Britain has traditionally been protected from imports of non-British fresh pasteurised liquid milk because of the difficulty of moving a highly perishable and bulky product across a maritime border, but it is open to imports of tradable manufactured products, such as butter and cheese. Consequently, consumer demand for liquid milk is characterised by relatively inelastic demand compared to the market for manufactured products, which is relatively more price

³ Recent brands launched include Wiseman's *The One* (low fat) milk, Dairy Crest's *St Ivel Advance* omega 3 enriched milk, Arla's *Cravendale Hint Of* flavoured extended shelf life milks and Milk Link's UHT long-life *Moo* milk. National retailers' have also recently launched a number of new own label brands, including Tesco Pure filtered milk and GM-free milks in Sainsbury's and Marks and Spencer. In the organic sector, new brands include *Rachel's Organic* milk launched in 2002, *Yeo Valley Organic* milk, which was re-launched in 2006 in partnership with OMSCo, and Dairy Crest's *Country Life Organic* milk launched in 2006.

elastic (Swinbank, 1986; Defra, 2001⁴). This is generally reflected in the pricing of raw milk by the processing sector, with dairy producers receiving a much higher price for raw milk destined for liquid consumption than for raw milk used in the manufacture of (commodity) dairy products. This premium (known as the 'liquid premium') is paid to command priority of supply given the perishable nature of fresh pasteurised liquid milk and the fact that consumer demand remains relatively constant throughout the year, despite the seasonal nature of raw milk production at farm level.

The liquid milk market was traditionally the principal value added dairy product market in Great Britain (Erskine and Atkinson, 1995), and to some extent determined the scale of the 'liquid premium' payable to raw milk producers supplying this market. However, changes that have occurred in the liquid milk distribution channel since the 1980s have had an immense impact on the level of added value this sector can offer.

Historically, the main distribution channel for the sale of fresh processed milk was the *doorstep delivery system* (Section 3.5.1). During the 1980s, virtually all British households had liquid milk delivered to their doorstep by the dairy processing sector⁵. With around half of all raw milk produced in the UK utilised by the liquid milk market, this dominance afforded the British dairy processing sector control of the fresh liquid milk market, offering pricing flexibility and limiting its exposure to the multiple retail sector.

However, since the 1980s there has been a radical shift in the sale of fresh liquid milk from the doorstep distribution system to supermarkets, as national multiple retailers' bargaining power, and the emergence of retailers' own label brands, expanded (Collins, 1997). By 2005, only 11% of British households had liquid milk delivered to their doorstep. This growing share of sales through the national multiple retailers has altered the balance of power within the chain and British liquid milk processors have relinquished their pricing flexibility, and hence the bargaining power, which they once commanded.

During this time, British milk processors have been confronted with an inexorable gross margin decrease, in what was a declining market⁶. As liquid milk moves away from the doorstep delivery system, it is generally marketed under the supermarkets' own label brand. Consequently, it loses its added value and becomes just another commodity with a lower margin being made per litre by the milk processing companies; during the mid-1990s, British milk processors' margins made on milk sold through the supermarket were half that made on milk sold through on the doorstep (average 5-6% compared to 10.5-11.5%, respectively) (CSFB, 1998).

⁴ Own-price elasticities, estimated by Defra (2001), for a selection of milk and dairy products indicate that the demand for cheese, for example, is more responsive to price changes than liquid milk. Specifically, estimated own price elasticities show that a 1% increase in the retail price of cheese will result in a 0.35% reduction in demand. This compares to a smaller reduction in the demand for milk, of 0.17%, as a result of a 1% increase in its retail price.

⁵ Via franchised/managed milkmen or independent milkmen (Section 3.5.1).

⁶ Recent data suggests that this decline may have been arrested (Table 3.3, Section 3.5).

This loss in added value to fresh liquid milk has had significant implications for the milk processing sector and the dairy industry at large, particularly given the importance of the liquid milk market in terms of raw milk utilisation. During the 1990s, Erskine and Atkinson (1995) argued that with the exception of the declining doorstep delivery system, the processing sector added comparatively little value to raw milk⁷. More recently, the House of Commons (2000) noted that there had been little investment in domestic product innovation following deregulation of the industry and similarly the Competition Commission (1999) noted that the sector had become less competitive in internationally traded products.

Despite recent innovations in processing technology and numerous launches of differentiated and branded liquid milks, the British liquid milk market is still dominated by retailers' own-label brands. With the vast majority of liquid milk remaining an unbranded and homogenous product, this essentially exposes the British liquid milk sector to competition based on price; consequently liquid milk is not the industry's most profitable product (Dairy UK, 2006). Given the importance of the liquid milk sector in terms of raw milk utilisation, this restricts the ability of the whole industry to increase profitability throughout the supply chain.

2.4. Trade position

The volume of raw milk produced in the UK is limited by production quotas under the EU dairy regime. The UK's current quota is equivalent to about 90% of its consumption of liquid milk and dairy products. The UK is therefore a net importer of certain liquid milk and dairy products, such as cheese, butter and yoghurt (Table 2.3) as well as UHT liquid milk.

Table 2.3: UK trade balance by products, 2000-2005 ('000 tonnes)

	2000	2001	2002	2003	2004	2005
Liquid Milk	38	-26	20	40	202	451
Cream	75	68	76	99	67	61
Yoghurt	-126	-130	-134	-182	-169	-132
Buttermilk	-13	-18	-18	-45	-74	-91
Butter	-84	-78	-95	-84	-91	-108
Butter oil	7	11	13	10	12	23
Cheese	-203	-205	-205	-230	-240	-256
WMP	91	78	103	96	91	39
SMP	39	7	12	16	27	-15
Milk and dairy products	-176	-293	-228	-280	-175	-28

Source: Eurostat

⁷ Before deregulation of the industry in 1994 (1995 in the case of Northern Ireland), dairy processors were guaranteed a pre-determined rate of return under the CATFI formula pricing policy. Thus, incentives to innovate and diversify into growing markets, such as added value products, were reduced (Ritson and Swinbank, 1991; Tweddle and Doyle, 1993). Moreover, a processor wishing to innovate and diversify into new product markets would have to negotiate a milk price for the new utilisation under the end-use pricing policy in the Joint Committee. For example, a cheese processor wishing to diversify into the speciality cheese market instead of producing Cheddar would have had to pay up to 23% more for its milk (Pitts, 1990). Thus, the incentive to produce added value products, with a greater degree of risk, was considerably reduced, as it simply increased the milk price for the new utilisation (Ritson and Swinbank, 1991).

Similarly, the UK has a negative trade balance in value terms, estimated at £893 million in 2005. This deficit has been growing steadily, as growth in the value of imports over the years has exceeded that of exports (Figure 2.3). However as shown in Table 2.3, the UK's negative trade balance has been decreasing in volume terms. This implies that the UK is an importer of added value products (such as certain high value yoghurts and cheeses) and an exporter of low value bulk commodities (such as milk powder (which rely heavily on EU export subsidies), bulk cream and in particular bulk liquid milk which has a relatively high volume/weight to value ratio).

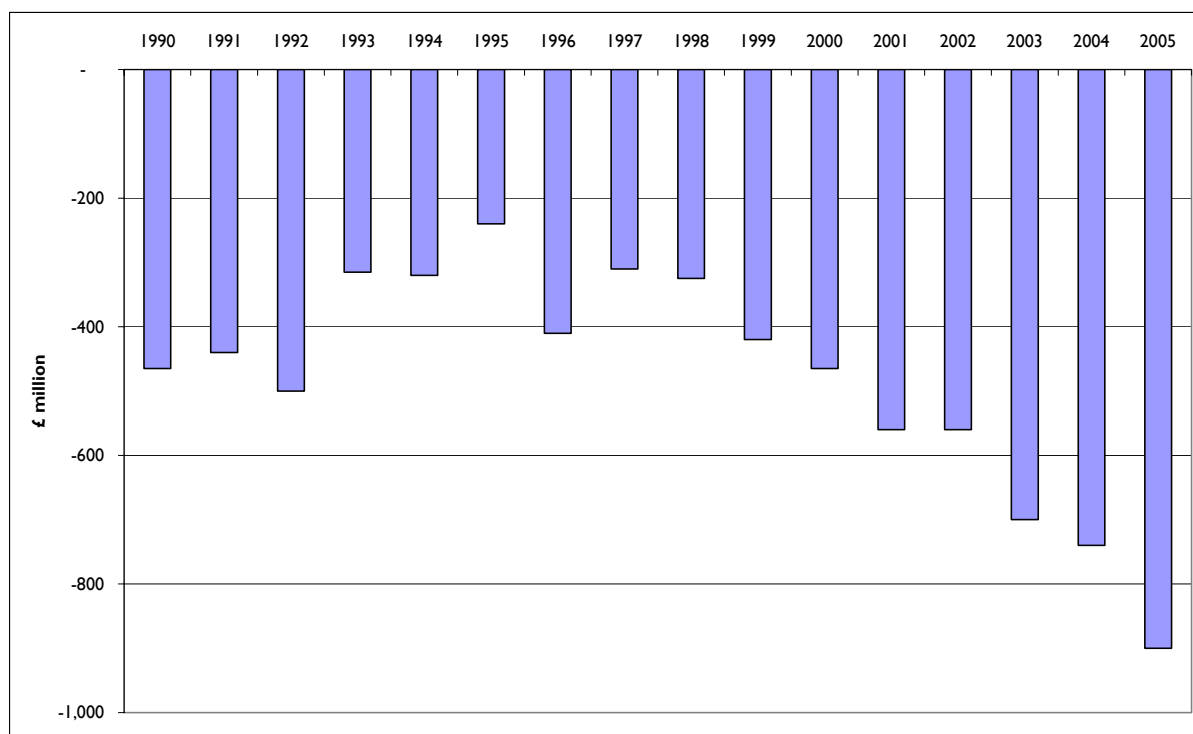


Figure 2.3: UK dairy trade balance, 1990-2005

Source: Eurostat

A similar trend can be observed for liquid milk trade. Although the UK is a net exporter of liquid milk, with exports growing significantly in recent years (Figure 2.4), the overall value of these exports has increased by a lesser amount (Figure 2.5).

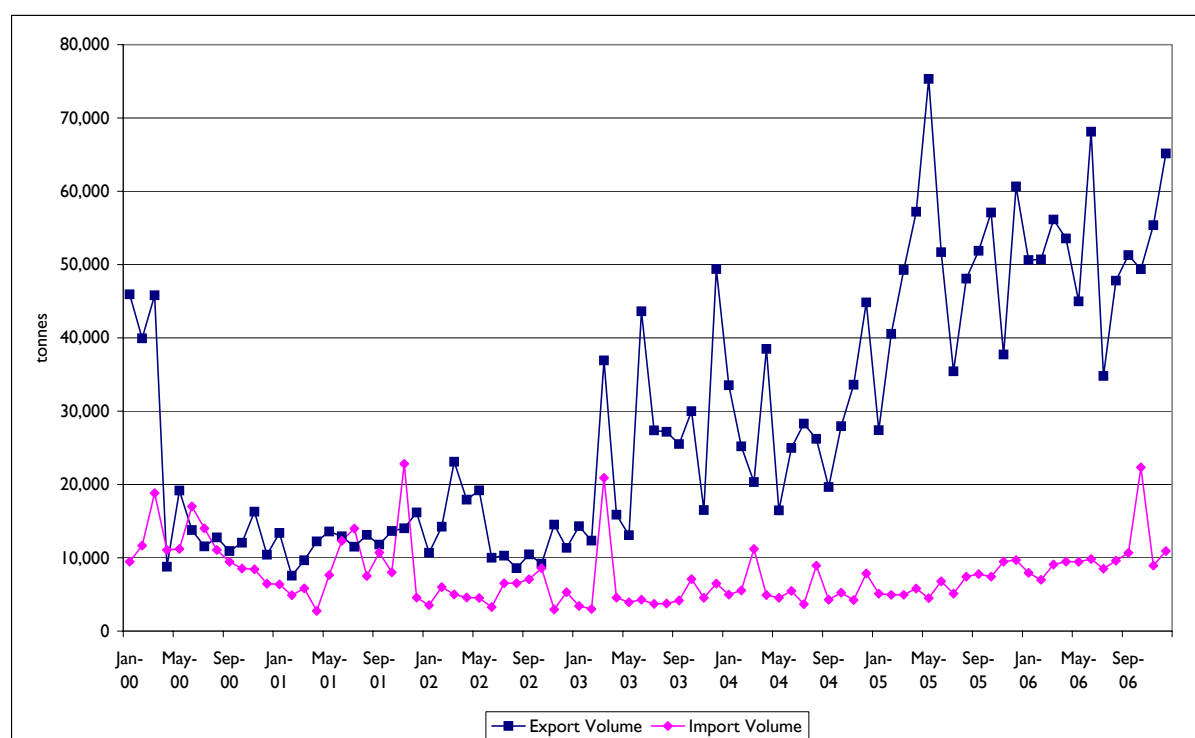


Figure 2.4: UK trade in liquid milk, volume

Source: Eurostat comext

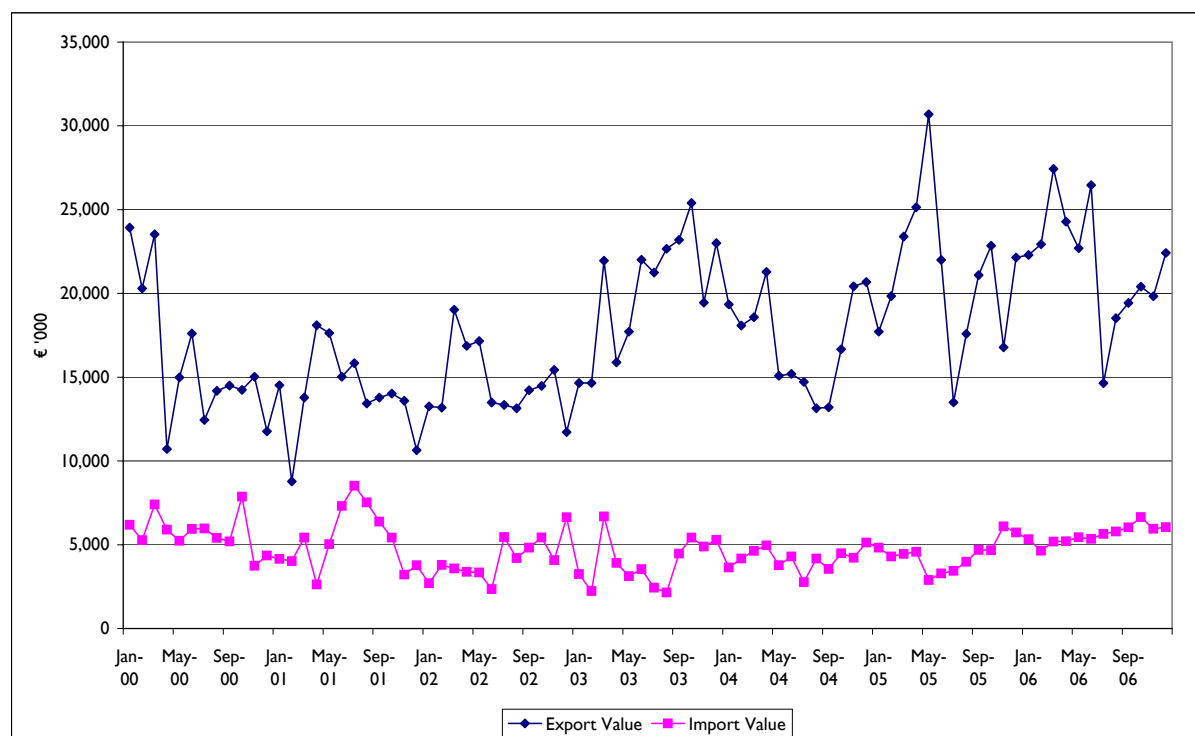


Figure 2.5: UK trade in liquid milk, value

Source: Eurostat comext

Much of this export growth in recent years has been in trade of low value bulk milk between Northern Ireland and Southern Ireland. In 2006, (Southern) Ireland accounted for 88% of all liquid milk exports from the UK (Table 2.4). Other key export destinations include Belgium, Germany, France, the Netherlands, Italy and Spain. Key import markets include Ireland, Germany, Denmark, Belgium, France, the Netherlands and Italy.

However, trade data does not allow a break down by UK region (e.g. Northern Ireland versus Great Britain) or by individual liquid milk product category (e.g. fresh pasteurised milk versus UHT milk, raw milk versus processed milk). Inferences cannot therefore be made on the extent of trade in liquid milk in raw versus processed form and in fresh versus UHT form between Great Britain and other Member States. To the extent that information was forthcoming, evidence gained during this study on the scale and nature of trade that has taken place and is likely to take place is presented in Section 4.

Table 2.4: Liquid milk trade between the UK and third countries, volume (tonnes)

	2000	2001	2002	2003	2004	2005	2006
Imports							
Ireland	65,394	64,166	29,443	38,530	28,309	11,475	21,911
Germany	25,208	18,434	13,815	12,443	15,478	39,305	49,788
Denmark	25,924	7,687	2,770	3,343	3,708	2,606	493
Belgium	7,239	4,086	3,423	3,907	11,556	9,953	25,434
France	10,558	11,718	11,562	9,149	10,240	12,025	16,573
Netherlands	549	828	2,297	1,851	1,039	3,229	9,221
Italy	689	488	532	508	455	278	52
Other	1,605	27	18	43	48	73	241
Total imports	137,165	107,434	63,860	69,774	70,833	78,945	123,712
Exports							
Ireland	152,666	60,580	64,341	198,129	255,805	520,113	660,824
Belgium	39,179	42,071	45,425	54,821	48,615	45,894	58,762
Germany	28,242	21,633	26,201	26,323	17,212	13,767	20,134
France	20,723	20,745	17,606	24,385	9,913	7,802	6,328
Netherlands	2,208	2,557	3,370	4,460	4,295	1,755	1,432
Italy	378	504	753	699	824	508	601
Spain	154	168	295	839	1,906	1,312	2,984
Other	3,793	1,252	1,433	2,365	850	1,096	1,740
Total exports	247,343	149,509	159,424	312,021	339,419	592,247	752,805
Net trade	110,178	42,075	95,564	242,247	268,585	513,303	629,093

Source: Eurostat

That said, Table 2.5 presents the level of net trade in liquid milk between the UK and third countries, excluding Ireland. Over the period the UK has generally been a net exporter of liquid milk with the exception of 2006. However, when not considering Ireland as a partner country, trade in liquid milk between the UK and other countries is minimal, ranging from 0.03% of deliveries to dairies in 2005 to 0.57% in 2003.

Table 2.5: Liquid milk net trade between the UK and third countries (excluding Ireland), volume (tonnes)

	2000	2001	2002	2003	2004	2005	2006
UK milk deliveries to dairies	13,932,000	14,156,000	14,359,000	14,554,000	14,114,000	14,038,000	n.a.
Net liquid milk trade	22,906	45,661	60,666	82,649	41,090	4,664	-9,819
Trade as a % of deliveries to dairies	0.16%	0.32%	0.42%	0.57%	0.29%	0.03%	-

Source: Agra CEAS calculations based on Eurostat and Defra

2.5. Market definition and implication for industry consolidation

The rationale for this research⁸ is that: *"there is currently very little trade in raw or processed liquid milk between the UK and mainland Europe, or between Great Britain and Ireland. For this reason, the liquid milk market in Great Britain tends to be regarded as national at its widest. This has implications for the way competition authorities consider proposed mergers"*.

Under UK law, the competition authorities must take action if they believe that there is a 'realistic prospect' that a merger will substantially lessen competition. In a recent speech at a Dairy UK Conference the Office of Fair Trading outlined its position on competition policy with respect to the British dairy sector (Fingleton, 2006) and in particular concerning horizontal mergers within the sector and the issue of *market definition*.

Horizontal mergers are mergers that take place between firms active at the same level of the supply chain (i.e. those that compete directly with each other for market share). Where the merging parties both produce a number of dairy products, the proposed merger will be assessed in the 'market' context for each product separately and in so doing the competition authorities will develop their own definition of what constitutes the 'market' for each product (Fingleton, 2006). Box 2.1 sets out the competition authorities' view on 'market definition'.

⁸ As set out in the *Specification of Requirements* to this research, issued by Defra.

Box 2.1: Market definition - the competition authorities' view

"In asking whether a merger will reduce competition, a competition authority examines what would be the principal sources of competitive pressure on the merged company. Market definition is simply a useful tool in categorising those sources into those that are stronger and less strong.

It would be wrong to think of market definition as dividing other companies into 'competitors' and 'non competitors'. Rather, where we define the market – and we do not always need to do so – those 'in' the market offer more immediate competitive pressure than those 'outside' the market. Those inside may not offer full competition, and those outside may offer some. Market definition is not an exact science and we always look beyond the defined market and analyse competition from more distant competitors, and new entrants.

The OFT is required to assess each merger on its specific facts. Because market definition is centrally focussed on the merging parties, and relies on responses of third parties, we should not expect it to produce the same answer for every case. For example, if A and B are close substitutes and C is a weak substitute, then if A and B merge, C would not constrain the merged entity, but if A and C merge, B would constrain them. In all of our market definition, we rely on standard international methodology."

Source: Fingleton (2006)

Over the last 10 years, the competition authorities have examined around 20 mergers in the dairy sector, of which 17 (85%) were cleared after an initial investigation by the Office of Fair Trading (Fingleton, 2006). Three mergers were referred by the Office of Fair Trading to the Competition Commission. These were: Wiseman/Scottish Pride (1996); Arla/Express (2003); and Wiseman/SMD (2005). In each case⁹, the competition authorities have considered market definition.

Fingleton (2006) points out that a particular concern has arisen over what constitutes the geographical scope of the fresh liquid milk market. This concern centres on the extent to which more geographically distant, and particularly overseas, suppliers represent a strong source of competitive pressure. The competition authorities currently have no evidence to believe that imports and exports of raw milk and fresh liquid milk into and out of Great Britain take place in significant quantities. Rather, their evidence suggests that the supply of raw and fresh liquid milk within Great Britain remains in effect insulated from competition from abroad. In this respect, they currently consider the relevant market to be defined as at most Great Britain-wide (Fingleton, 2006). However, in the case of the proposed Wiseman/SMD merger, the market was defined as at most Scotland-wide (Fingleton, 2006), mainly due to strong consumer preference for Scottish milk (Section 3.4.3).

In contrast, since there is evidence that UHT milk, bulk cream, butter and cheese are traded across UK boundaries in significant quantities, the competition authorities consider the markets for each of these products to be wider than the UK. Accordingly, when Dairy Farmers of Britain acquired Associated Cooperative Creameries, the Office of Fair Trading considered the relevant market to be Europe-wide.

⁹ With the exception of Wiseman/SMD, which was abandoned by the merger parties.

According to Fingleton (2006), it does not follow from this that the British liquid milk sector is precluded from further consolidation; market definition is only the starting point when investigating horizontal mergers within an industry, with other factors such as the ability of new players to enter the market being considered. This research addresses this point by assessing the potential for trade in liquid milk between Great Britain and mainland Europe.

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3. Barriers and impediments to trade in liquid milk

3.1. Conceptual overview

Following the formation of the Single European Market in 1992, all duties, tariffs and quotas on trade within the Community were abolished. This resulted in the elimination of significant cost increasing *formal*¹⁰ intra-EU barriers to trade, facilitating the free movement of capital, labour, goods and services between Member States. Transaction costs (i.e. transport and marketing costs) associated with intra-EU trade were reduced thereby increasing the possibility of exploiting *arbitrage*¹¹ opportunities in the EU.

It would therefore have been expected that following the formation of the Single European Market in 1992 and the implementation of common EC rules on milk hygiene in 1994, intra-EU trade in liquid milk, as in other product areas, would have been encouraged. Although subsequently there has been some growth in intra-EU trade of liquid milk (particularly long-life milk) between other EU Member States, trade between the United Kingdom and mainland Europe (and between Great Britain and Ireland) has been minimal, suggesting that significant barriers or impediments to trade still exist. Consequently, the liquid milk market in Great Britain tends to be regarded as national at its widest

Economic theory purports that the presence of arbitrage opportunities equalises prices between markets. The basic economic analysis of trade relies on the *spatial equilibrium* concept¹², which suggests that related markets will interact through trade towards an equilibrium or balance between supplies and demands in different locations, thereby equalising prices (Harvey and McLeay, 1996). The proposition that the presence of arbitrage opportunities tends to equalise prices is known as the *law of one price*. This law states that in the absence of transaction costs, trade leads to the establishment of a common market price.

While empirical analysis has demonstrated that the *law of one price* holds for highly tradable (commodity) products (see for example: Miljkovic, 1999), it has proved invalid in a number of studies (see for example: Engel and Rogers, 1996; 1999; Froot, Kim and Rogoff, 1995; and Haskel and Wolf, 1999). According to Jørgensen (2003), deviations from the *law of one price* is a measure of the degree to which barriers to trade between markets exist (i.e. the extent to which arbitrage between markets is impeded). Since there are no longer any *formal* intra-EU trade barriers within the Community, any deviation from the *law of one price* between markets will be attributable to *informal* trade barriers.

¹⁰ Formal barriers to trade are defined as direct actions taken for the purpose of limiting imports (Menzie and Prentice, 1987).

¹¹ Arbitrage is the competitive process of taking advantage of a price differential between two or more markets. For instance, it would be profitable for producers or merchants to export products from lower priced to higher priced markets.

¹² This analysis assumes the theory of trade according to the theory of comparative advantage and specialisation (Harvey and McLeay, 1996).

Informal trade barriers are varied in form, but generally impact on trade indirectly (Menzie and Prentice, 1987). They can include economic, logistical, structural and technological impediments and risks.

According to Jakobsson (2000), the geographical separation of markets often prevents price equalisation from taking place due to differences in the size of transport and transaction costs between locations; distance is positively correlated to transportation costs (which may cause price variations in the price of tradable inputs) and the further apart two locations are situated, the higher the probability that there is different cost and technological structures between locations (differences in these structures could cause uncorrelated variations in prices of traded as well as non-traded inputs). Moreover, if two locations are separated by a national border, Jakobsson (2000) states that informal trade barriers could imply additional price discrepancies. These observations are in line with conclusions drawn by Engel and Rogers (1996; 1999) that have shown that significant informal trade barriers still exist within free trade areas such as the EU.

Acknowledging that price discrepancies exist between markets, Harvey and McLeay (1996) note that in reality, competitive and efficient markets establish a chain of inter-related prices for the same (commodity) product at different geographic locations and at different stages in the marketing chain. Each price is related to the next by the cost of transporting, transforming and marketing the product.

However, the cost of transport and storage can often result in substantial differences between prices at different locations and in different time periods. Using fresh liquid milk as an example, Harvey and McLeay (1996) note that these informal trade barriers are sometimes sufficiently high to prevent trade between places (or storage between time periods). Instead, processed substitutes form the major traded and stored commodities rather than their fresh counterparts thereby overcoming the informal barriers associated with the product in its fresh (unprocessed) and non-storable form.

This Section provides an overview of those informal barriers that create an impediment to trade in liquid milk between Great Britain and other European Member States. These are discussed under the headings transport costs, economies of scale and efficiency, consumer preference, access to distribution channels and markets, and exchange rates.

3.2. Transport (collection, trunking and distribution) costs

Economic theory claims that transport costs form a significant informal barrier to trade (see for example: Jakobsson, 2000). In explaining why relatively little trade in liquid milk takes place between Great Britain and other European Member States, the cost of transport is frequently cited as forming the main barrier (see for example: Erskine and Atkinson 1995; MDC, 2006). This is primarily because milk is typically a bulky, perishable and typically low value product, relative to the cost of transport.

3.2.1. Transport costs

The overall cost of transporting (i.e. collecting, trunking and distributing) liquid milk is a function of a number of individual cost components, which can be classified as either fixed costs (independent of mileage) or variable costs (depending on mileage and usage). Fixed costs include the cost of the vehicle (depreciation), insurance, road tax and overhead charges. Variable costs include labour (wages), fuel, vehicle tyres, repairs and maintenance.

According to the Road Haulage Association (2007), the cost of fuel and lubricants and the cost of labour (drivers' wages, NI contributions and subsistence and other expenses as well as fitters' wages for repairs and maintenance) account for almost two-thirds (62.2%) of the operating costs of goods vehicles (Figure 3.1). With the exception of vehicle insurance, which has increased by 581% since 1989¹³, these main cost components have increased by the greatest amount over the period; the cost of fuel and lubricants has increased by 281% and the cost of labour has increased by 211% for drivers and 213% for fitters (Figure 3.2).

Moreover, with the exception of road tax, finance charges and vehicle depreciation, which only account for 8.3% of total goods vehicles operating costs (Figure 3.1), all cost categories have shown above inflation increases since 1989 (Figure 3.2). As a result, the total operating cost of goods vehicles has increased ahead of inflation each year between 1994 and 2005 (Figure 3.3).

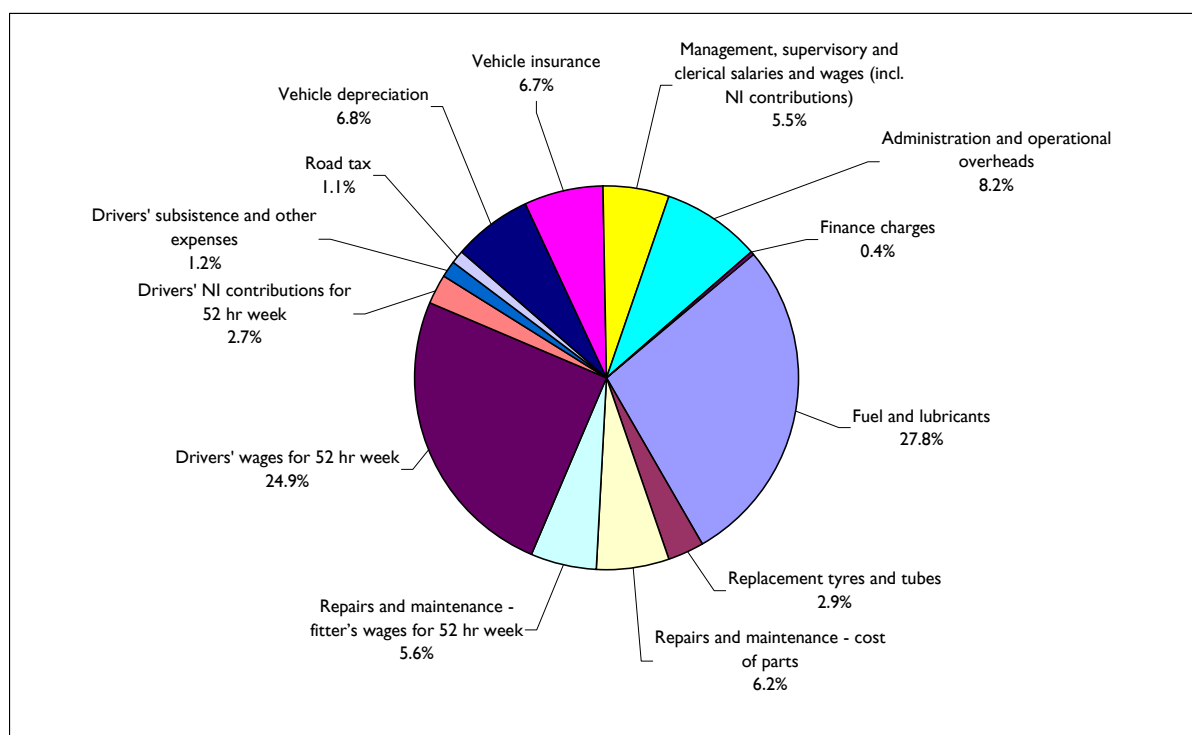


Figure 3.1: Breakdown of goods vehicle operating costs (01/10/05 to 30/09/06)

Source: Road Haulage Association

¹³ and now accounting for 6.7% of total operating costs.

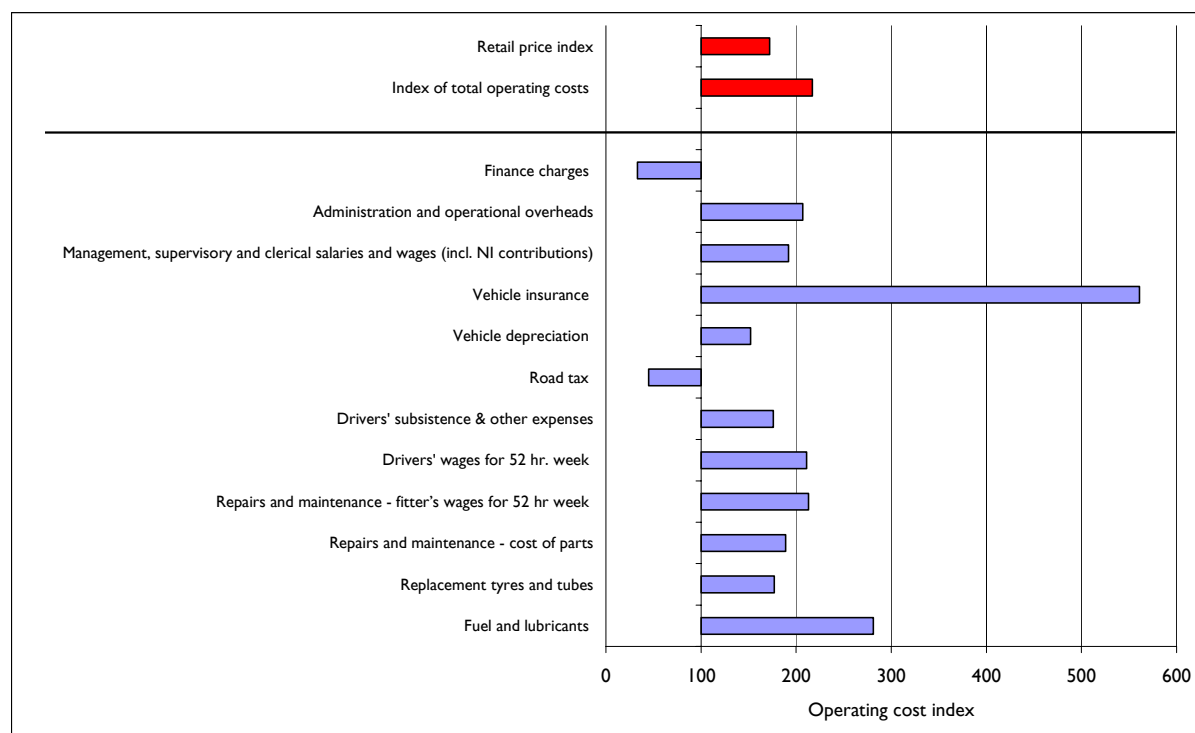


Figure 3.2: Index of goods vehicle operating costs, 30/09/06 (1989=100)

Source: Road Haulage Association

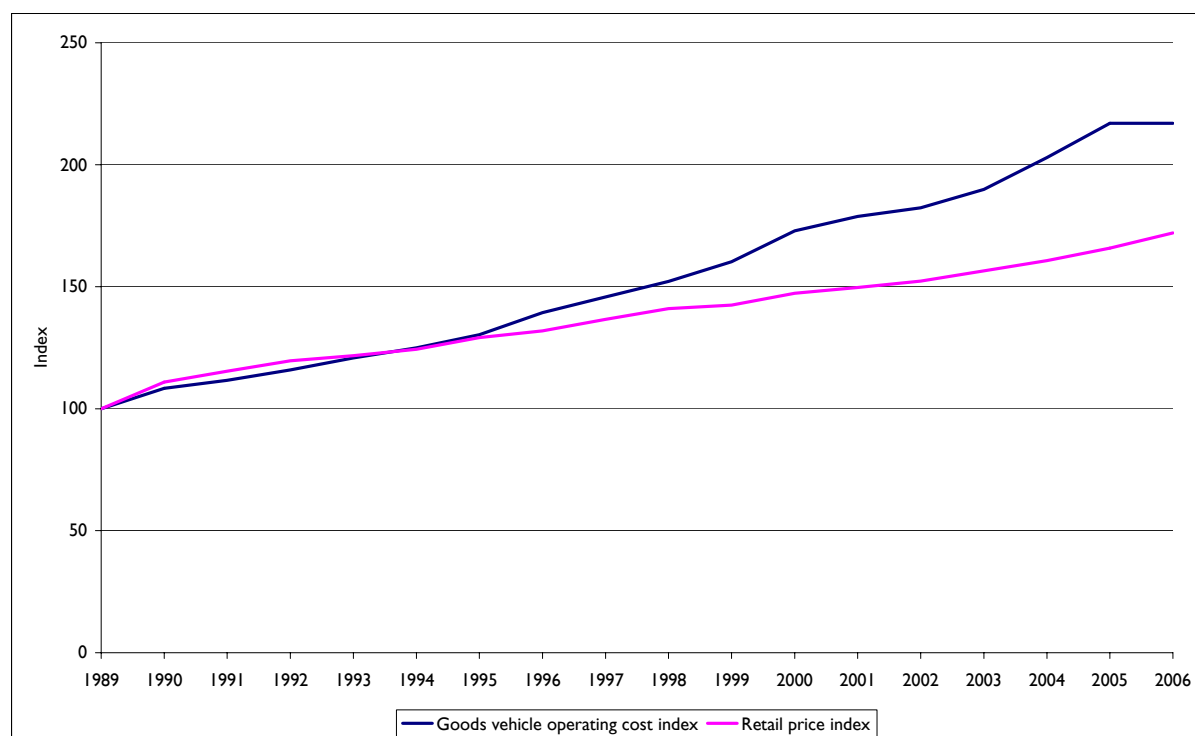


Figure 3.3: Index of goods vehicle operating costs and retail price index

Source: Road Haulage Association

3.2.2. The cost of transporting liquid milk

Despite these above inflation annual cost increases, it would appear that transport costs have not necessarily formed a significant barrier to transporting milk over greater distances over time. In this respect there is evidence that liquid milk is being transported over greater distances within Great Britain (see for example: Monopolies and Mergers Commission, 1996; Competition Commission, 2000) and, furthermore, following discussions with liquid milk processors, there is evidence that liquid milk is being traded between Great Britain and particular European Member States (Section 4). That said, this trade is currently relatively small.

Although the underlying costs of transport have increased over the period, the dairy sector has been able to capitalise on significant operational efficiencies which have to some extent mitigated these cost increases, thereby facilitating increased trade both within Great Britain and between Great Britain and particular European Member States. Based on discussions with the industry, the average cost of milk collection and delivery to the dairy typically ranges from 0.9ppl to 1.0ppl. It should be noted that the cost for some milk collections may fall well outside this range for numerous reasons, such as the geography and size of the milk field, average pick-up volume and size of milk tanker. This compares¹⁴ to a cost of between 0.4ppl and 1.4ppl in the late 1990s, based on a survey of milk processors (Competition Commission, 1999). This would suggest that the aforementioned significant operating efficiency improvements have limited the extent to which the per litre cost of transporting liquid milk has increased over time.

The cost of distributing packaged milk was found to be considerably greater than the cost of collecting milk, over the same distance. This is because a litre of packaged milk will occupy a greater space by virtue of its packaging than a litre of milk in a bulk tanker. In addition, for health and safety reasons, there is a limit to the number of litres of milk that can be stacked on a single milk trolley and loaded on refrigerated trailers. Furthermore, according to the industry there is more variation in the average cost of distributing milk both between milk processing companies and between distribution channels/market outlets. In this context, multiple deliveries direct to middle ground customers¹⁵ are generally more expensive than a single delivery direct to a multiple retailer's store.

The aforementioned significant operational efficiencies which the dairy sector has been able to capitalise on include:

- **Raw milk collection and trunking.** Structural change at farm level has resulted in an increase in the average volume of raw milk collected per farm. This is primarily due to the reduction in producer numbers over time and the resultant increase in average herd size and milk yield. This has resulted in the reduction in milk collection points (from 35,741 producers in 1995 to 21,616

¹⁴ This comparison is illustrative purposes only; different survey methods and samples were used in each case.

¹⁵ All retailers other than the national multiples, public sector bodies, catering customers, bottled milk buyers and other wholesalers.

in 2004) and an increase in daily milk collection volumes (from 1,087 litres in 1994/5 to 1,687 litres 2004/05), offering significant potential gains in milk collection operational efficiency. These operational gains have been further enhanced following the introduction of every other day collections (although some liquid milk processors implement every day milk collections only) (Table 3.1).

Table 3.1: Impact of structural change on milk collection

	1995/96	2004/05
Number of dairy producers	35,741	21,616
Average herd size (cows)	72	92
Average annual milk yield (litres)	5,512	6,694
Average daily milk collection per producer (litres)		
- every day collection	1,087	1,687
- every other day collection	2,175	3,375

Source: MDC datum

In addition to reductions in average milk collection points and increases in milk collection volumes, fleet management initiatives have enabled further operational cost savings to be realised. The average size of milk collection tankers has generally increased, allowing greater volumes to be picked up by fewer vehicles. Moreover, the implementation of flexible farm collection times by some companies has increased the collection window within which milk can be collected, thereby improving optimum fleet use (i.e. reducing vehicle downtime) and thus further increasing the volume of milk collected by a single vehicle.

Further fleet management initiatives which have provided significant cost savings include an integrated milk collection service; a single milk tanker collects raw milk from farms on behalf of different milk buyers thereby saving the need for two 'competing' milk tankers to operate milk collection services within the same milk geographical area. In addition, some raw milk buyers/processors have contracted out the whole milk collection, trunking and distribution process to specialist milk hauliers. For example, Wincanton achieved an 8% reduction in the cost of milk collection for First Milk through a combination of milk collection synergy savings; staffing efficiencies; waste management improvements; CIP (cleaning in place) efficiencies; and improvements in fleet profile (Wincanton, 2007).

- Packaged milk trunking and distribution. The cost of transporting packaged (processed) milk is a function of the *drop density*, the *volume transported*, the *distance travelled* and the *journey time*. There have been a number of procurement changes at retail level that have impacted on the operational efficiency of packaged (processed) milk trunking and distribution and hence the overall cost of transporting packaged (processed) milk:
 - For the multiple retail sector, the demise of the doorstep delivery system and the subsequent increase in sales of liquid milk from supermarket outlets has necessitated the

procurement of increased volumes of milk per store. At the same time, consolidation of the retail sector has resulted in fewer delivery points for these larger volumes of milk. The growth of 'out of town' superstores with appropriate investment in infrastructure and dedicated goods delivery areas has led to an increase in the average size of vehicles that are able to make these deliveries as the need to enter 'small' town centres is often avoided.

- For the middle ground, smaller vehicles are generally used, making a larger number of deliveries of smaller volumes of milk per drop off. However, more sophisticated computer software packages to maximise the efficiency of delivering liquid milk are being used. These software packages assist in the optimum ordering of multi-drop and multi-trip routes, based on the information on fleet vehicle capacities, average speed on different road types, drivers' shift patterns and regulations on working time, etc.. In addition, fleet management initiatives have enabled further operational cost savings to be realised, as discussed for the collection of raw milk.

Over the medium term, the cost of milk collection, trunking and distribution is expected to continue to evolve in line with structural and procurement changes at farm and retail level, as well as changes in the underlying cost categories. Specifically, the cost of fuel and labour (which accounts for almost two-thirds of the operating costs of goods vehicles (Figure 3.1)) is likely to come under increasing pressure in the medium-term. There is concern that journey time may increase (i.e. increased labour costs) as a result of congestion. Road use is growing rapidly due to economic growth and consequently Eddington (2006) warns that parts of the road system are under serious strain; if left unchecked the rising cost of congestion will result in 13% of traffic being subject to stop-start travel conditions in England by 2025. In terms of future fuel costs, in the short to medium-term the Chancellor's March 2007 Budget statement noted that an increase in fuel duty on diesel would be deferred until October 2007, with an increase of fuel duty by 2p per litre in 2008 and by 1.8p per litre in 2009. Beyond this, the outlook will depend on the trend in oil prices and government policy on fuel duty, both of which cannot be forecast without any degree of certainty but would be expected to rise at least in line with inflation. In addition, the possibility of more motorway charging tolls and national road pricing schemes will add further to the absolute cost of transport.

In the medium to long-term, the cost of transport will remain a significant barrier to trade in liquid milk both within Great Britain and between Great Britain and other European Countries. This is primarily because milk is typically a bulky, perishable and typically low value product, relative to the cost of transport.

3.2.3. The cost of importing/exporting liquid milk

Although the UK competition authorities view the liquid milk market as Great Britain at its widest (Section 2.5) and there is evidence that liquid milk is being transported over greater distances, the question arises as to why liquid milk is not traded regularly across Britain's maritime border. The distance between Dover in England and Calais in France, for example, is only 21 miles and the

opening of the Channel Tunnel in 1994 has significantly reduced Channel crossing times to a mere 20 minutes. According to the industry interviews, the industry believes that trade in conventional undifferentiated liquid milk is not currently commercially viable due to the additional cost of crossing Britain's maritime border (although in certain circumstances for certain liquid milk product categories trade occurs (Section 4)).

These additional costs include the absolute cost of the ferry crossing/transit through the Channel tunnel. However, when considering the cost of transport as a barrier to trade, the industry frequently cited that *journey time* is as much a consideration as *distance*. This is particularly so given that drivers' wages were found to account for a quarter of goods' vehicle operating costs (Figure 3.1). Thus, when considering the additional cost of crossing Britain's maritime border, the *opportunity cost* of the additional time spent checking in, boarding and disembarking as well as the actual transit time should be factored in. Check-in times alone commonly range from 1-2 hours for ferry crossings.

In addition, 'risk' was cited as a further barrier to crossing Britain's maritime border. Any delays to crossing times (e.g. bad weather, strikes or port blockades) could add significantly to the cost of transport (in terms of additional labour costs and the opportunity cost of lost business). At worse, due to the perishable nature of liquid milk, serious delays may lead to spoilage and rejection of complete loads.

Looking forward, there is concern that the risk of delays to crossing Britain's maritime border may increase in the medium to long-term without additional investment in port capacity and efficiency. Freight shipping demand has grown rapidly in the UK in recent years and is forecast to outstrip existing and currently anticipated port capacity beyond 2020 (Eddington, 2006). Thus, without further expansion, port facilities are likely to become increasingly congested, which would likely result in increased journey times and costs. This would further impede trade in liquid milk between Great Britain and other Member States, given its perishable and bulky nature. However, if the recommendations made by Eddington (2006) are implemented, then additional investment in deep-sea port capacity, with additional feeder port capacity and expanded roll-on roll-off capacity, are expected to offer some economic benefits which could to some extent lower impediments to trade.

3.3. Economies of scale and efficiency

3.3.1. Raw milk production

Dairy farmers in Great Britain are among the most efficient in the EU (MDC, 2006). Dairy production in Britain benefits from favourable climatic conditions and significant scale economies in farm structure (average herd size and average milk yields per cow (Section 3.2.1)). As a result, Great Britain has significant cost advantages in liquid milk production, creating significant barriers to importing raw liquid milk. Apart from Ireland, production costs in other neighbouring Member States are significantly higher (IFCN, 2005).

However, despite these significant cost advantages, the cost of exporting liquid milk (i.e. both transport and transaction costs) is currently in excess of the raw milk price differential between Great Britain and other neighbouring Member States (as discussed in Section 4.3.1). This forms a considerable barrier to exporting raw liquid milk from Great Britain.

3.3.2. Liquid milk processing and packing

Dairy companies tend to specialise by focusing on either liquid milk processing or dairy product manufacture. One of the underlying reasons for this specialisation include the particular needs of fresh processed milk supply, such as its relatively short shelf life (Section 3.4.2) as well as the fact that it is a relatively high-volume, low-margin product for which physical distribution costs and performance are crucial (Section 3.2).

Wijsman (1999) suggests that economies of scale and capital requirements provide a significant barrier to entry for new entrants for most dairy products world-wide. Since deregulation of the dairy industry in 1994, the liquid milk processing sector has undergone a series of mergers and acquisitions. This has been followed by the rationalisation of old processing capacity and investment in new processing capacity, in pursuit of the significant economies of scale that exist in milk processing.

The industry believes that this investment has been necessary in order to remain competitive in servicing the detailed demands of the national multiple retailers (Section 3.5.3). According to trade information presented by KMPG (2002), actual milk processing costs¹⁶ are around 5ppl for plants with a throughput of 100 million litres per year, falling to around 2ppl for output above 300 million litres per year (Table 3.2).

Table 3.2: Economies of scale in fresh liquid milk processing

Plant size (annual capacity - million litre)	Production costs (pence per litre)
100	5
200	3
300	2

Source: KMPG (2002)

Because of these efficiencies there has been a trend towards introducing new or replacement capacity in the form of large scale 'super dairies'. According to the Competition Commission (2003), there is no established definition of a 'super dairy'. However, in general the industry considers that super dairies have the following characteristics:

- large processing capacity, typically in excess of 400 million litres per year;
- favourable location, close to major population centres with good access to the road network;

¹⁶ Excluding raw milk procurement costs, transportation costs and distribution costs.

- modern layout and facilities; and,
- modular design that allows for future expansion at relatively low capital costs.

However, there is a trade-off between operating and capital cost efficiencies arising from the progressive replacement of smaller dairies by large-scale super dairies and increased distribution costs. The industry believes that the trend towards large-scale super dairies often leads to increased transportation distances for raw and processed milk. That said, operating and capital cost savings from the creation of super dairies, additional demand for processed milk by the multiple retailers (Section 3.5) and recent efficiency gains in transportation (Section 3.2.2) have maintained the viability of transporting liquid milk over greater distances. It therefore follows that failure to capitalise on further scale economies¹⁷ (where they exist) may to some extent prevent the liquid milk processing sector from trading-off resultant operating and capital cost savings with the additional cost of trading liquid milk over greater distances (possibly including crossing Britain's maritime border).

The fresh liquid milk market is now serviced principally by three large companies, namely Arla Foods UK, Dairy Crest and Wiseman Dairies. Of these, Arla Foods UK and Wiseman Dairies focus mainly on the liquid milk market, while Dairy Crest also services other markets such as cheese and fresh dairy products. All three companies operate large scale processing plants, including super dairies¹⁸. As a result of such investment, the British liquid milk processing sector operates some of the newest and most efficient dairies in Europe (Dairy UK, 2006). This provides British liquid milk producers with a significant cost advantage *vis-à-vis* other European fresh liquid milk processors, particularly given that fresh liquid milk in many European countries tends to be more of a niche product (Section 2.2), and therefore produced in smaller scale dairies.

The converse is, however, true in British UHT milk processing capacity. According to the industry, Britain lacks economies of scale and efficiency in UHT milk processing to compete with its European counterparts. Part of this is because British demand for UHT milk is relatively small at 8% of the total liquid milk market (Section 2.2). Consequently, British production of UHT milk tends to be produced in relatively smaller plants.

In mainland Europe, UHT milk is processed in larger plants, thereby capitalising on the significant economies of scale that exist in milk processing. The use of larger plants is possible partly because national demand for UHT milk is generally higher in mainland Europe, but also because UHT processing is generally undertaken as a balancing activity by the processing sector. This further provides additional cost savings as UHT milk production is thus undertaken to coincide with the seasonal peak in raw milk production when the cost of sourcing raw milk is at its cheapest.

¹⁷ Through additional expansion of existing, or investment in new larger, super dairies (as long as diseconomies of scale do not set in).

¹⁸ These include Arla UK's Stourton, West Yorkshire dairy, Dairy Crest's Chadwell Heath, London and Severnside, Gloucestershire dairies and Wiseman's Dairies Droitwich, Worcestershire and Trafford Park, Manchester dairies.

Given that UHT milk can be transported over longer distances than fresh milk, since it does not need expensive refrigerated transport, trade barriers are relatively low. As a result, UHT milk is regularly imported into Great Britain from neighbouring EU Member States, including France, Germany and Belgium. It was reported that these products can currently be competitively sourced on the British market because, to some extent, lower UHT plant operating efficiencies in neighbouring EU Member States, compared to those in Great Britain, effectively offset the cost of importing UHT milk, subject to exchange rate movements (Section 3.6).

However, the volume of UHT imports are to some extent limited by the nature of UHT milk production in these countries. Currently, most of the imported UHT milk is supplied to the discount retail sector (as well as some middle ground customers), where price is generally the criteria which determines choice of procurement. The main multiple retailers in Great Britain impose a number of rigorous requirements that suppliers have to meet (Section 3.5.3), one of which is that all products supplied have to conform to agreed quality standards such as shelf life. Due to the seasonal nature of UHT production in many neighbouring EU Member States, a consistent supply of UHT milk with a consistent shelf life length cannot be guaranteed throughout the year.

In contrast, UHT milk in Great Britain is produced throughout the year thereby allowing retailers to source UHT milk that is able to conform to quality standards concerning shelf life. Such stringent requirements by the multiple retail sector have effectively limited the potential to increase UHT imports, despite the operational cost disadvantages of British UHT processors. Similarly, British UHT processors' operational cost disadvantages effectively constrains the level of exports from Britain to other EU Member States. That said, there is clear evidence that under certain circumstances trade in branded UHT milk takes place (Section 4).

Finally, it was noted by the industry that the opportunity costs of butter and SMP production as a balancing operation for milk processors were greater than the production of UHT milk. Therefore, it was considered unlikely that investment in UHT plant would be undertaken to lower the operational barriers to facilitate British exports at lower cost.

3.4. Consumer preference

3.4.1. Taste

The British liquid milk market is to some extent protected by imports by virtue of its strong preference for fresh pasteurised milk, and the converse is true for exports to mainland Europe, where UHT milk is preferred. According to the industry, only Ireland, Denmark and Finland are significant consumers of fresh pasteurised milk. As such, these countries have significant fresh pasteurised milk processing capacity and capability and could form potential suppliers of large volumes of milk to the British market, subject to overcoming other impediments to trade such as the cost of transport. Similarly, subject to overcoming such impediments to trade, these countries could form potential markets for British fresh pasteurised (or extended shelf life) liquid milk, particularly in

the case of Finland and Denmark given the relative farmgate cost advantage of British liquid milk (Table 4.5, Section 4.3.1).

In neighbouring EU Member States, consumers generally have a strong preference for UHT milk rather than fresh pasteurised milk. Only 35% of German processed liquid milk sales are of fresh pasteurised milk, 20% of Dutch and under 10% in France (KPMG, 2002). Consequently, fresh pasteurised milk processing capacity and capability in these countries tends to be relatively smaller than in Britain. Moreover, in the Netherlands and France the fresh pasteurised liquid milk is seen as a niche premium market (KPMG, 2002).

3.4.2. Perishability

The perishable nature of fresh liquid milk has traditionally formed a significant impediment to trade. If all other barriers could be overcome, the distance that fresh liquid milk could be transported would be limited by the shelf life of the milk. However, demands for longer shelf life and wider distribution of milk and milk products have resulted in the development of processes and packaging concepts to increase the shelf life of these products in cold chain distribution (Rysstad and Kolstad, 2006).

According to the industry, over the last 20 years the shelf life of fresh liquid milk has doubled from 5-6 days to around 11 days. This has been achieved without any fundamental changes to the process of milk separation¹⁹, homogenisation²⁰ and pasteurisation²¹ itself, but primarily through:

- improvements in the bacteriological content and quality of raw milk at the farm level;
- technical improvements during milk processing, which have resulted in the production of fresh processed milk with a lower bacteriological content;
- improvements in milk bottle filling technology, with innovations such as atmosphere control and non-contact fillers; and,
- improvements in refrigeration and management of the cool chain from farm to retail.

Such technical and logistical improvements have no doubt facilitate the increasing distances which liquid milk is currently transported within Britain (Section 3.2). However, recent innovations in milk processing technology have extended the shelf life of milk even further. The application of micro filtration technology, which takes out 'more' of the bacteria that causes milk to sour, in the production of fresh pasteurised liquid milk has led to the introduction of a new extended life milk. These filtered milks typically have an extended shelf life of around 20 days (and last seven days once opened), which is double that of conventional fresh liquid milk.

¹⁹ Separation is the process using centrifuges to remove surplus cream from the milk.

²⁰ Homogenisation is the process of applying high pressure to ensure that the remaining fat content is distributed throughout the milk uniformly.

²¹ Pasteurisation is the process whereby the milk (and cream) is heated rapidly to 74°C for 25 seconds and then cooled rapidly to 4°C.

There are three brands of filtered extended life milk on the market at present, accounting for around 4% of the total milk market in 2006 (Murden, 2006). Arla Foods was the first to launch fresh milk using this technology in 1998, in the South East of England, with its brand *Cravendale*, before launching UK-wide in 2002. Wiseman entered the market in 2005 with a Tesco own-label product, *Pure Milk*, before launching its own brand, *Puriti*, in 2006.

While filtered extended life milks are still considered to be a niche sector, sales continue to trend upward (Figure 2.2, Section 2.2) and further marketing and promotional campaigns are planned for 2007 onwards. As this product category has increased in importance, so has its geographical scope for trade, with both *Cravendale* and *Puriti* being actively exported to other European countries (Section 4). This would suggest that the relatively short shelf life of fresh milk has traditionally been a considerable impediment to trade.

3.4.3. Provenance

Historically, virtually all households purchased their fresh liquid milk requirements from the doorstep delivery system (Section 3.5.1), with this milk generally having been sourced locally/regionally. With the demise of the doorstep delivery system and shift in the sale of fresh liquid milk to supermarkets, the sourcing of liquid milk for retail stores became more national as the multiple retailers' purchasing strategies moved from central authorisation to central purchasing. This increased the geographical scope for trade in fresh liquid milk *within* Great Britain, although as detailed in Section 3.5.3 other impediments to trade have generally prevented the import of liquid milk from outside Great Britain to service this retail channel. Accordingly, competition authorities tend to regard the market for fresh liquid milk as Great Britain at its widest (Section 2.5).

In recent years, there has been much debate about consumer attitudes to 'origin' for liquid milk and dairy products and renewed interest in using national or regional origin as a selling point (European Commission, 2006). Although fresh pasteurised liquid milk is generally branded by the multiple retailers as 'British milk' in the English market, in Scotland and Wales fresh pasteurised liquid milk is marketed as 'Scottish milk' and 'Welsh milk', respectively. The multiple retailers (and increasingly a greater proportion of selected middle ground customers (e.g. restaurants)) in Scotland and Wales require milk supplies to be sourced from Scottish and Welsh farms, respectively.

In recent years, the issue of 'local food' has been attracting considerable policy and public interest (Morris and Buller, 2003); there is increasing evidence that the British processed liquid milk market is becoming further differentiated with more 'local' branding of milk (e.g. Yorkshire milk and West Country milk). Recently, one leading multiple retailer announced that it is to launch a new liquid milk that will be locally sourced from 150 dairy farmers and marketed in local stores at a slight price premium under the brand 'localchoice'. Such local branding will also appeal to the growing segment of consumers who believe that local sourcing reduces the environmental impacts of road transport.

The extent to which the increased importance placed on provenance within the British liquid milk market has been retailer or consumer driven is, however, not clear from the literature, or from discussions with the industry. While Scottish consumers have been found to be statistically more likely to show a preference towards milk produced in Scotland than consumers in northern England are to show a preference towards milk produced in England (Box 3.1), this may be due in part to investment by the multiple retailers in 'Scottish' branded milk, and the lack of a similar investment in a 'North of England' brand.

Box 3.1: Evidence on consumer preference and willingness to pay for regional milk

Consumer preference for regional milk - research undertaken by Express Dairies

Express Dairies added three questions to a monthly omnibus survey carried out by a market research company in Scotland. One of the questions asked whether, all other things being equal, Scottish consumers would choose to buy milk produced in Scotland or milk produced in England. 91% of respondents said that they would choose milk produced in Scotland and none said they would choose milk produced in England.

Results of a survey into consumer preferences for milk in northern England showed that, when asked a similar question, 51% preferred to purchase milk produced in England, 33% did not know and 13% said that they would purchase milk produced in Scotland.

Willingness to pay for regional milk - research undertaken by Express/Calymore Dairies

Express/Calymore commissioned research to assess Scottish consumers' willingness to pay more for Scottish milk than English milk in middle-ground stores; the survey asked consumers if they were going to buy milk from a corner/grocery store, as opposed to a supermarket, would they prefer to buy English milk at 50ppl or Scottish milk at 55ppl. The survey found that twice as many consumers would prefer to buy the more expensive Scottish milk (59%) than the cheaper English milk (29%); the remainder either did not know or did not purchase milk.

Consumer preference and willingness to pay for regional milk - research undertaken by the Competition Commission

The Competition Commission (2000) commissioned a number of questions for inclusion in an omnibus survey of over 1,000 people across all Scottish constituencies to gauge the extent of preferences for milk produced in Scotland by asking consumers whether, if they were offered two brands of milk of the same quality, freshness and taste, they would buy the brand that was produced in Scotland or the cheaper brand. Just over a half (54%) said that they would purchase the brand produced in Scotland, while 32% said that they would purchase the cheaper brand. However, only 14% of the consumers surveyed said that they had paid more for milk solely because it was produced in Scotland and 50% said that they would buy cheaper milk brought in from Northumberland if it were offered in their local shop (as opposed to 33% who said they would not).

Moreover, 40% of respondents to the survey said that where milk came from was more important than how much it cost. Conversely, 34% said that what the milk cost was more important than where it came from. 18% of respondents said that they made a point of using only shops that sold Scottish-produced milk, as against 75% who said that they did not.

Source: Competition Commission 2000

Evidence from various industry surveys focusing on the Scottish liquid milk market (Box 3.1) suggests that Scottish consumers have a strong preference for Scottish milk, where there is no difference in price between Scottish-produced and English-produced milk. However, when consumers were asked about their willingness to pay a higher price for Scottish milk if a cheaper alternative were

available, the preference for Scottish milk fell and a significant minority stated that they would purchase the cheaper brand.

Consumers' reluctance to pay a higher price for regional milks reduces the importance of provenance as a barrier to entry, where cheaper alternatives are available. However, the extent to which alternative 'imported' milks (either from different British regions or overseas) pose a threat of substitution is generally considered marginal by the industry. Given the principal retailers' policy on sourcing liquid milk supplies from Scottish and Welsh farms for their Scottish and Welsh stores, the only other significant outlet for liquid milk would be the less discerning (in terms of origin) middle ground customers. However, given that these customers are likely to procure only one brand of milk, stocking decisions would probably be made on the basis of what the majority of their customers preferred.

According to the industry, even if there is a less discerning middle ground customer base that would be prepared to take 'imported' milks from different British regions or overseas, it was considered unlikely that this customer base would be large enough to achieve the economies of scale required in procurement, production and distribution of 'imported' milk. This would mean that a milk processor would be faced with the delivery option of both regional and 'imported' milks on the same distribution round. However, it was considered that it would probably be inefficient to separate the procurement, production and order-picking operations of a dairy in order to supply both regional and 'imported' milks.

In addition, the British raw milk market became further differentiated in 1993 following the implementation of EU legislation which provides for a system for the protection of food names on a geographical basis, namely Protected Designation of Origin²² (PDO) and Protected Geographical Indication²³ (PGI). In the UK, there are twelve cheese manufacturers²⁴ and one cream manufacturer²⁵ producing products with PDO and PGI status. Although there are no liquid milk processing companies, these dairy product manufacturers must source their raw milk locally, thereby precluding any option of import of raw milk from outside the defined local milk field.

The importance of these niche product markets has generally been increasing over time, as they have been in other EU Member States, thereby precluding export of British raw milk to these product markets. While, such products are expected to maintain their popularity among those more affluent and discerning consumers, these are expected to remain niche markets utilising a relatively small amount proportion of national milk supplies.

²² Products which are produced, processed and prepared within a particular geographical area, and with features and characteristics which must be due to the geographical area.

²³ Products which must be produced or processed or prepared within the geographical area and have a reputation, features or certain qualities attributable to that area.

²⁴ Beacon Fell traditional Lancashire cheese (PDO), Bonchester cheese (PDO), Buxton blue (PDO), Dorset Blue cheese (PGI), Dovedale cheese (PDO), Exmoor Blue cheese (PGI), Single Gloucester (PDO), Swaledale cheese (PDO), Teviotdale cheese (PGI), Stilton - White cheese (PDO), Stilton - Blue cheese (PDO), West Country farmhouse Cheddar cheese (PDO).

²⁵ Cornish Clotted Cream (PDO).

In summary, the British liquid milk and dairy market is increasingly being differentiated by origin of raw milk production, thereby requiring the procurement of raw milk from distinct national and regional milk fields. Current and planned initiatives to brand milk on a more local basis, primarily by the multiple retail segment, will increase the level of differentiation further. This has created a very significant barrier to entry for raw milk supplies outside these national and regional milk fields, as well as for the import of liquid (raw or processed) milk into Great Britain from other European countries. Similar trends are being observed in the food industry in other EU Member States (European Commission, 2006), thereby increasing barriers to export of liquid (raw or processed) milk from Great Britain to other European countries.

3.5. Access to distribution channels and markets

Total (household and non-household) purchases of liquid milk have remained relatively stable over the period presented in Table 3.3. This stability, however, masks considerable changes that have taken place between different distribution channels. The main distribution channels and markets for liquid milk are the national multiple retailers²⁶, the middle ground customers (which can be further divided into the middle ground retailers²⁷ and middle ground non-household sales outlets²⁸) and doorstep customers.

Table 3.3: Processed liquid milk purchases in Great Britain, by distribution channel

	Household Purchases				Non-household purchases		Total purchases
	Doorstep		Retail		million litres	%	
	million litres	%	million litres	%			
1990	3,708	58%	1,795	28%	911	14%	6,414
1991	3,532	55%	1,923	30%	913	14%	6,368
1992	3,251	51%	2,144	34%	959	15%	6,354
1993	2,967	47%	2,365	37%	1,006	16%	6,338
1994	2,605	41%	2,648	42%	1,041	17%	6,294
1995	2,565	39%	3,076	47%	874	13%	6,515
1996	2,194	34%	3,205	50%	1,048	16%	6,448
1997	1,937	30%	3,301	52%	1,156	18%	6,394
1998	1,755	28%	3,327	52%	1,290	20%	6,372
1999	1,533	24%	3,414	53%	1,549	24%	6,496
2000	1,304	20%	3,509	55%	1,590	25%	6,403
2001	1,106	17%	3,759	59%	1,532	24%	6,397
2002	937	15%	3,814	60%	1,645	26%	6,396
2003	782	12%	3,921	63%	1,564	25%	6,267
2004	637	10%	4,085	64%	1,666	26%	6,388
2005	524	n.a.	4,263	n.a.	n.a.	n.a.	n.a.

n.a. = not available

Sources: Data for 1990-1994 - The Dairy Council; data for 1995-2005 - TNS, Defra, DARD

²⁶ Namely, Asda, Marks and Spencer, Morrisons, Sainsbury's, Somerfield, Tesco and Waitrose.

²⁷ All retailers other than the national multiples.

²⁸ Including public sector bodies, catering customers, bottled milk buyers and other wholesalers.

3.5.1. Doorstep delivery

Historically, the main distribution channel for the sale of fresh processed milk was the *doorstep delivery system*. This distribution system is fairly unique in the EU, in that British liquid milk processing companies process, bottle and supply fresh processed milk to franchised/managed milkmen or independent milkmen (known as bottled milk buyers) via milk depots (Section 3.5.2). These milkmen deliver milk to consumers' doorsteps within defined inherently *local* areas. For franchised/managed milkmen, liquid milk is supplied within these areas exclusively on behalf of a single liquid milk processor.

At the beginning of the 1980s virtually all British households had fresh processed milk delivered direct to their doorstep by milkmen. This dominance afforded the British milk processing sector control of the fresh processed milk market. The doorstep distribution channel thus constituted a colossal barrier to entry (Erskine and Atkinson, 1995), given a new entrant's requirement for an outlet for its milk. Any foreign liquid milk processor looking to export fresh processed milk to the British market would need to trade with a bottled milk buyer (i.e. independent milkman) or establish its own doorstep customer base.

Evidence from the industry interviews suggests that doorstep customers, where competition exists, rarely switch between doorstep suppliers making it difficult for potential new entrants to obtain an economically viable customer base, particularly given the doorstep delivery system is in decline. Between 1995 and 2005, sales of liquid milk on the doorstep have fallen by 80% from 2,565 million litres to 524 million litres, accounting for 10% of total liquid milk purchases (compared to 39% in 1995).

Even if a foreign milk processing company could establish a doorstep customer base in Great Britain, there are supply and demand characteristics specific to this distribution channel that maintain a high level of entry barrier to the British doorstep market. From a demand perspective, liquid milk is generally delivered to the doorstep in one pint glass bottles rather than non-returnable containers. This would require, from a supply perspective, investment in glass bottling facilities (or a contract with a liquid milk bottler in Great Britain to overcome the logistical problems and costs associated with transporting glass bottles over long distances).

3.5.2. Milk depots

Milk depots are used by milk processors to deliver large quantities of liquid milk for onward delivery in smaller quantities to both doorstep and small middle ground customers (e.g. independent retailers). According to the industry, refrigerated milk depots are readily available to rent. As such, access to doorstep and middle ground customers via milk depots is not considered to form a barrier to imports of liquid milk.

3.5.3. Retail - multiple retailers

Milk processors deliver milk to multiple retailers either directly from their dairies or via distribution depots. In either case multiple retailers require that milk is delivered daily and direct to their individual stores²⁹, rather than their regional distribution centres (RDCs), within delivery slots of typically 1-2 hours. The need for daily delivery has remained unchanged over time, despite increases in the shelf life of fresh processed milk (Section 3.4.2), in line with their *just in time* sourcing strategies which limits the need for investment in expensive cold storage facilities at each store.

In general, national multiple retailers centrally negotiate with milk processors to supply fresh liquid milk to some or all of their stores. While some national multiples purchase milk from only one milk processor, others source from multiple milk processors. However, multiple retailers have been reducing the number of suppliers from which they procure milk over time. Between 1998 and 2003, the average number of milk processors supplying the national multiples fell by 1.50, from 3.75 to 2.25 suppliers (Table 3.4). Since 2003, there has been further contraction in the supplier base; for example in 2004 Arla Foods became sole supplier of fresh processed milk to Asda. Most fresh processed milk sold by the national multiple retailers is currently processed by the largest three British milk processors, namely Arla UK, Dairy Crest and Wiseman.

Table 3.4: Number of suppliers¹ of fresh processed milk to national multiple retailers

	1998	2003
Asda	3	3
Marks and Spencers	3	1
Morrisons	3	1
Safeways	4	2
Sainsbury's	4	3
Somerfield	6	3
Tesco	6	4
Waitrose	1	1
Average number of suppliers	3.75	2.25

¹ excludes suppliers of small volumes of differentiated products

Source: Competition Commission (2003)

Although this rationalisation in the supply base for fresh processed milk has been in line with consolidation in the British milk processing sector, the need for suppliers to meet a number of rigorous requirements imposed by the national multiple retailers does to some extent limit their supply options. These retailers' demand daily and timely supply of appropriate volumes of liquid milk, at the right quality and service level direct to their stores. Investment in super dairies to capitalise on the economies of scale in milk processing and geographic scope in distribution (Section 3.3.2) with the primary purpose of supplying the multiple retail sector at the right quality and service level has enabled Arla UK, Dairy Crest and Wiseman to gain the majority share of this distribution channel.

²⁹ with the exception of Marks and Spencer and Waitrose, where fresh processed milk is delivered direct to their regional distribution centres (RDCs).

The multiple retailers' service requirements include the need for all products to be clearly date-coded, fully traceable from farm to consumer and conforming to defined quality standards (such as shelf life, seal performance and milk quality) and defined factory standards (including processes and procedure, with evidence of satisfactory performance in the technical audits of all factories) and distribution standards (including strict temperature control) (Competition Commission 2003). Furthermore, the multiple retailers carry out inspections to ensure suppliers are compliant with their service requirements. This is because suppliers of liquid milk are producing retailers' own-label brand milk. Accordingly, national multiple retailers need to guarantee product quality to limit any potential damage to their overall corporate image.

Due to the seasonal nature of UHT production in many neighbouring Member States, such requirements for shelf life impose a considerable barrier to imports of UHT milk for this retail outlet (Section 3.3.2). In the organic sector, the imposition of standards by some certification bodies in excess of the minimum laid down in EC Regulation 2092/91 on organic production, as amended by EC Regulation 1804/99, effectively prevents imports of organic milk from those EU Member States implementing the minimum standards. According to discussions with the industry, this effectively limits imports of organic milk to those neighbouring countries where production meets these additional standards (e.g. Belgium, Denmark, Germany and the Netherlands).

However, in recent years the multiple retail sector has been developing a strong commitment to British agriculture and has been increasingly sourcing only British products, where sufficient quantity is available subject to quality standards. This has included a commitment to sourcing British UHT milk and fresh British organic milk, as well as fresh British conventional milk. This requirement imposes a very significant barrier to imports of liquid milk, even if daily and timely deliveries could be guaranteed within delivery slots of typically 1-2 hours; importing milk over Britain's maritime border and generally transporting over greater distances increases the likelihood of delays (Section 3.2.3) and missing delivery slots.

Furthermore, this commitment to source British products has fostered a greater degree of vertical integration within the British supply chain, further raising barriers to potential trade (both in terms of securing supplies thereby limiting the need to look to overseas markets as well as preventing the need for dairy producers to look for other outlets for their raw milk). A number of dedicated supplier relationships have developed between the multiple retailers and dairy farmers, whereby a small price premium is paid for adhering to certain production standards. These include the Waitrose Select Farm Scheme, a partnership with Dairy Crest and 70 of its dairy farmers located in England and 1 dairy farmer located in Scotland (under the Scottish Select Farm Scheme), Marks and Spencer supplier partnership with both Dairy Crest and Wiseman dairy farmers, ASDA Farmer Partners with its dedicated group of 550 dairy farmers within the Arla Foods Milk Partnership, Tesco Localchoice milk supply partnership with Dairy Farmers of Britain's and 150 dairy farmers and Sainsbury's Dairy Development Group which will work with Dairy Crest and Robert Wiseman and around 450 dairy farmers.

3.5.4. Middle ground customers

According to the industry, middle ground customers generally impose less demanding standards in relation to the quality of milk procured than the national multiple retail sector. Most middle ground customers source a processor's own brand of liquid milk and thus rely on that processor's competence in food safety and other quality aspects. These less exacting standards create lower barriers to entry than to the multiple retail segment. As noted in Section 3.5.2, access to milk depots does not seem to provide any impediment to imports of liquid milk.

3.6. Exchange rate

Given that Britain is not part of the Euro-zone, any trade with other European countries will require the conversion of currency. Research by Engel and Rogers (1996; 1999) have shown that exchange rates cause significant trade barriers in free trade areas such as the EU. This is because there are transactions costs involved in converting one currency into another, which adds additional cost to trade. In the case of relatively low value products like liquid milk³⁰, this can form a significant proportion of the profitability of that trade.

Moreover, the need to convert currencies exposes companies to the risk of fluctuations in exchange rate. Exchange rate risk increases the costs for trade and discourages arbitrage activities (Jørgensen, 2003). Accordingly, exchange rate is a significant factor explaining why national borders (often referred to as the 'border effect') create significant price discrepancies for homogenous products between countries (Jakobsson, 2000), thereby violating the law of one price (Section 3.1).

Thus, while the introduction of the Euro should have reduced transaction costs and the 'border effect' for countries within the Eurozone, thereby enhancing competition, theory would suggest that trade with those European countries outside the Eurozone, such as Great Britain, may be impeded. However, this has not necessarily been the case. Since 2002, the value of Sterling has strengthened against the Euro (Figure 3.4). This should have made British based processing companies less competitive with those in other European countries. In an efficient market this should lead to a reduction in the volume of products exported and an increase in the volume imported.

However, as demonstrated in Section 2.4, export volumes have actually increased in recent years despite the relative strength of Sterling against the Euro. Thus, while previous research has found exchange rate to be an important impediment to trade across national borders, recent developments in the trade of liquid milk would suggest that this barrier has not been insurmountable. As noted in Section 2.4, most of this increased trade has been in the form of exports of raw milk between Northern Ireland and Southern Ireland. There has also been an increase in exports of branded UHT (Section 3.4.1) and extended shelf life milks (Section 3.4.2).

³⁰ With the exception of differentiated milks such as organic, extended shelf life filtered and branded milks.

That said, according to the industry the strengthening of Sterling against the Euro since 2003 has led to increased competitive pressures for British UHT milk processors from UHT milk imports. For example, Milk Link, the largest UHT milk producer in Britain, states in its 2005 and 2006 annual reports (Milk Link, 2005; 2006) that its UHT business has come under increasing threat from cheap imports of long life milk from other European Member States in recent years. This would suggest that at the current relative operating efficiencies of British-European UHT processors (Section 3.3.2), the present Euro-Sterling exchange rate signifies the 'tipping point' at which barriers to imports of UHT milk are lowered.

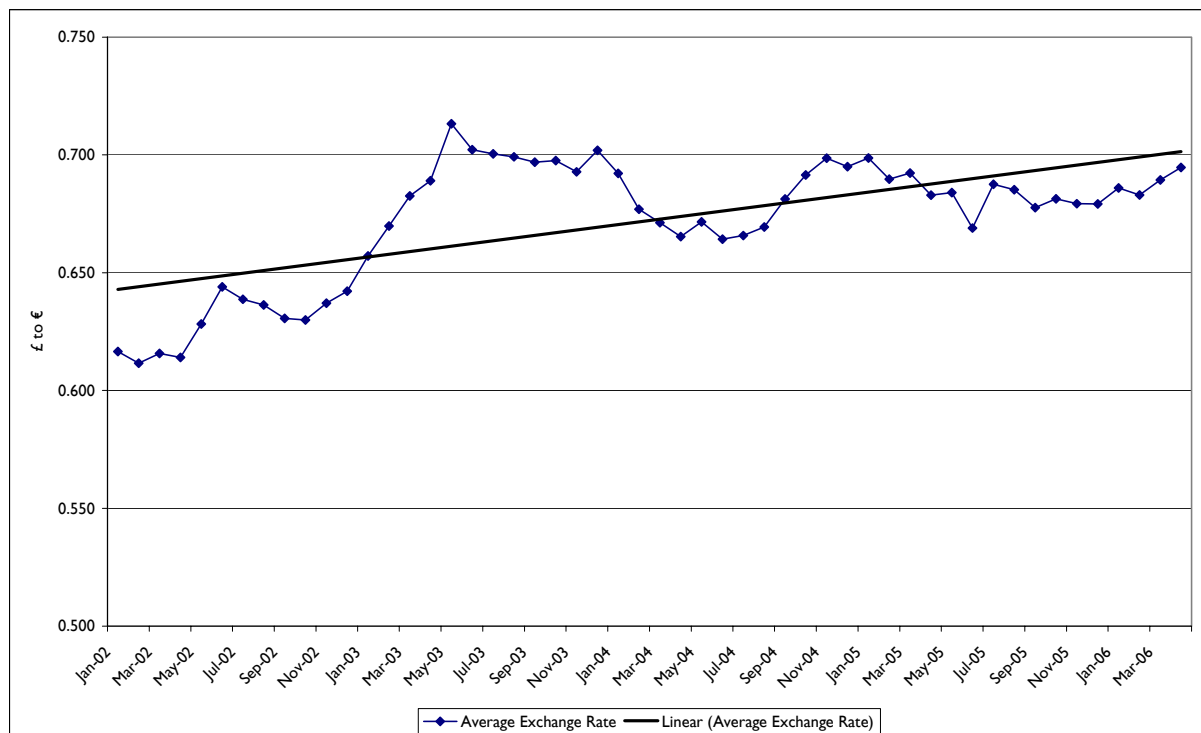


Figure 3.4: Trend in Euro - Sterling exchange rate

Source: Eurostat

3.7. Conclusion

Traditionally, Great Britain has been protected from trade in liquid milk by virtue of its maritime border and the cost of transporting a relatively bulky, perishable and low value commodity product. Significant transport cost savings have been achieved, despite increases in the underlying costs of transport. Along with increases in the shelf life of liquid milk, trade barriers have to some extent been reduced.

However, at the same time there have been increases in other impediments to trade relating to consumer preference and access to distribution channels and markets. These increases have resulted in significant trade barriers.

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4. Potential for GB-European trade in liquid milk

Having identified the barriers to trade in liquid milk between Great Britain and other EU Member States in Section 3, this Section specifies the likely circumstances under which trade in liquid milk between Great Britain and other EU Member States would become feasible. Specifically, a conceptual overview of the relevance of the theory of price determination and price discovery in the EU and UK milk markets is presented in the context of measuring the scale of economic *informal* barriers to trade in liquid milk, using the example of the EU and UK raw milk markets (Section 4.1). In Section 4.2, those barriers that form an economic impediment to trade in both bulk raw milk and processed packaged milk are quantified, using a transport distribution cost model. Finally, the circumstances under which trade in liquid milk is likely to be feasible is discussed in Section 4.3.

4.1. Conceptual overview

As discussed in Section 2, although there has been some growth in intra-EU trade of liquid milk since the formation of the Single European Market and implementation of common EC rules on milk hygiene, trade between the UK and mainland Europe (and between Great Britain and Northern Ireland) has been minimal. This would suggest that significant *informal* barriers to trade still exist, as described in Section 3.

From an economic perspective, the size of these barriers for a British based dairy processor, for example, is reflected in the cost differential between sourcing liquid milk from the UK (Great Britain) and the cost of sourcing liquid milk from other EU Member States. The economic process through which the price of liquid milk is determined is known as *price determination* and *price discovery*. *Price determination* is the process whereby the broad forces of supply and demand establish a general, market clearing, equilibrium price and *price discovery* is the process by which buyers and sellers arrive at a specific price for a given quantity of produce in a given location (Kohls and Uhl, 1990).

Theoretically, the operation of the intervention system for butter and SMP in the EU sets a ‘floor’ price to the market, known as the Intervention Milk Price Equivalent (IMPE). The ability of the industry to add ‘value’ to liquid milk will, amongst other things (e.g. supply and demand balance and level of competition in the market), determine the extent to which the liquid milk price is raised above this level.

However, as discussed in Section 3.1 the presence of arbitrage opportunities tends to equalise prices between (competitive) markets, the proposition known as the *law of one price*. That said, it was noted in Section 3.1 that the geographical separation of markets often prevents price equalisation from taking place due to the *informal* barriers to trade, namely the size of transport and transaction costs (i.e. transfer costs), between locations. This can often result in substantial differences between prices at different locations and in different time periods. Thus, the potential for a given country to import liquid milk limits the extent to which prices can be raised on any national (or regional) market, thereby setting a ‘ceiling’ price to the market.

By way of example, this process is depicted graphically for the raw milk market in the EU and UK in Figure 4.1. (Similar diagrammatic representations can be made for trade in other forms of milk.) Fearne and Ray (1996) explain that S_{UK} and S_{EU} are the supply curves for the UK and EU, respectively, with the vertical sections representing the respective quota levels. The respective demand curves for milk are given as D_{UK} and D_{EU} . As shown in Figure 4.1, supply and demand in the EU milk market is not in balance. The EU as a whole produces a surplus ($b-a$) and the UK has a deficit ($d-c$). IMPE sets a 'floor' price to the market which signifies the lowest price a manufacturer of commodity products for intervention can afford to pay for milk and still make *normal* profits. Conversely, the potential for imports prevents the UK milk price from rising above $IMPE+T$, where T represents the cost of transferring milk from the EU to the UK. This analysis assumes that the EU and UK milk markets are perfectly competitive³¹.

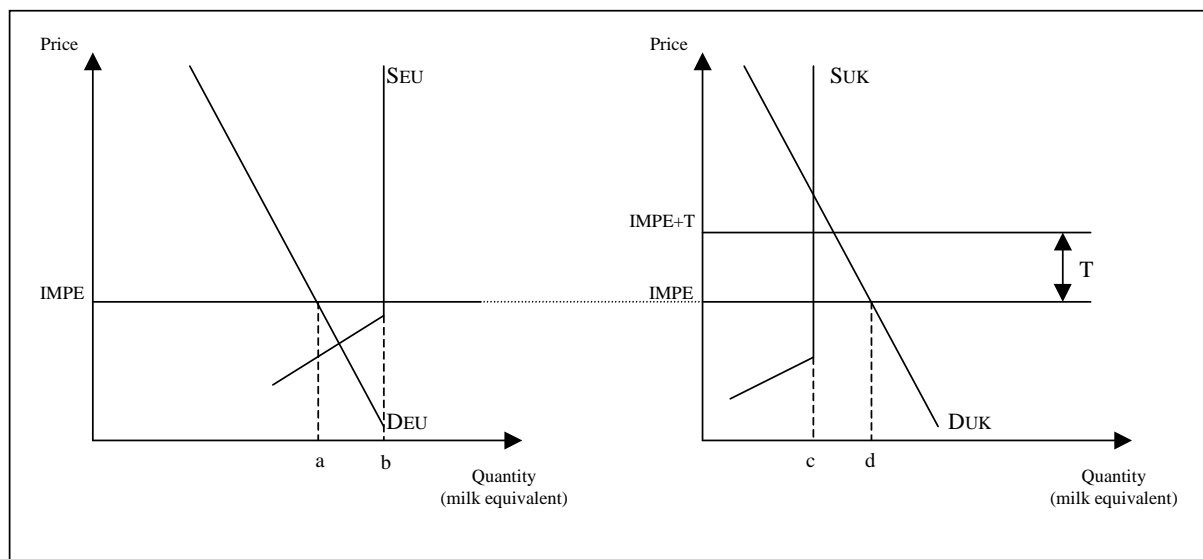


Figure 4.1: Price determination in the EU and UK dairy markets

Note: this diagrammatic representation (not to scale) of the EU and UK markets assumes perfect competition

Source: Fearne and Ray (1996)

In this context, 'T' represents the cost of the *informal* barriers to trade (i.e. the transport and transaction costs) in liquid milk, discussed in Section 3. Accordingly, Fearne and Ray (1996) state that the difference between $IMPE$ and $IMPE+T$ represents the scope for continued price discrimination within the UK milk market, reflecting the structural and imperfect competitive nature of the milk market. In this respect, milk processors based in other EU countries can also discriminate within the range $IMPE$ and $IMPE+T$. Accordingly, under imperfect competition the potential for trade arises when the difference between producer milk prices in two countries is greater than the transfer costs (i.e. transport and transaction costs).

³¹ Many buyers and sellers, each of whom is a price-taker rather than a price-maker; freedom for firms to enter and leave the market; perfect knowledge about prices and costs; and decision-makers whose primary concern is profit maximisation.

Whilst the value of these *informal* barriers is unknown, Ray and Fearne (1994) argue that they can be assumed to fall over time, as markets become further integrated as a result of more sophisticated distribution systems and improved cross-channel links. This would suggest that over time the scope for price discrimination will diminish, with the threat of imported milk and dairy products forcing the milk price down towards IMPE (Fearne and Ray, 1996).

The evidence presented in Section 3 would agree that significant gains in the operational efficiency of milk collection, trunking and distribution, and improved cross-channel links, have to a certain extent reduced the economic (quantifiable) barriers to trade. That said, there have been some important changes within the dairy supply chain over the last decade which have created very significant barriers to entry (e.g. changes in consumer preference and the demands of the different distribution channels and market outlets). The former category of trade barriers tend to be classified as *transport* costs and the latter generally come under the heading of transaction costs (i.e. the cost of negotiating, securing and monitoring trade). Due to the nature of such transaction costs as barriers to trade, they generally prove difficult to quantify.

4.2. Quantification of the *informal* barriers to trade in liquid milk

4.2.1. Transport distribution cost model

To quantify the extent to which transport costs form a barrier to trade in liquid milk, a transport distribution cost model was used. Specifically, this model calculated the overall cost, expressed on a pence per litre basis, of transporting bulk raw milk and processed packaged milk between Great Britain and a number of European countries, namely Belgium, Denmark, France, Ireland and the Netherlands.

The model is currently used commercially by a leading European transport and distribution company to calculate the cost of transporting products, such as liquid milk. The model therefore already contained all the necessary financial (fixed and variable) cost and technical data necessary to compute the real cost of transporting liquid milk between Great Britain and other EU Member States. Given that this cost model is used commercially by a specialist transport and distribution company, the costs generated include a profit element.

In calculating the cost of transporting liquid milk between Great Britain and other EU Member States, a number of assumptions have been made concerning the additional journey time, distance travelled, volume of milk transported and the actual cost of the sea crossing.

- Distance travelled. In calculating the cost of crossing Britain's maritime border, it has been assumed that an additional distance of 180 miles (290 km) is travelled. This equates to a distance of 45 miles to and from the port/terminal on either side of Britain's maritime border (equivalent to a total journey time of 4 hours).

- Journey time. The time cost (i.e. the *opportunity cost* of labour) involved in crossing Britain's maritime border is a function of the time required to check in and board the ferry/train, the crossing time and the time for disembarking (Table 4.1):
 - *Check-in times* commonly range from 1-2 hours for ferry crossings, depending on the route and operator, and 15 minutes for the Channel tunnel.
 - *Crossing times* differ by mode of crossing and route. Crossing times to France range between 35 minutes and 1.5 hours, depending on whether the Channel tunnel or the ferry is used. To the Republic of Ireland, the crossing time is approximately 3.5 hours. Crossing times to Belgium, the Netherlands and Northern Ireland are all in a similar range of between 9.5 and 12 hours. Crossings to Denmark take the longest at 17 hours.
 - As noted above, the *time to port/terminal and final destination* (which is a function of the distance travelled) is assumed to total 2 hours (on the basis of an average speed of 45 miles per hour) each way.
 - A turnaround time of 2 hours has been assumed for loading and unloading, which includes a risk factor for any unforeseen delays.

Table 4.1: Assumptions on journey time to cross Britain's maritime border

Destination country	Ports/terminals	Crossing time (hours)	Check - in time (hours)	Journey time to port/terminal and destination	Risk and turnaround
<u>Ferry</u>					
France	Dover-Calais	1.5	1.0	2.0	2.0
Netherlands	Hull-Rotterdam	11.0	1.5	2.0	2.0
Belgium	Hull-Zeebrugge	12.0	1.5	2.0	2.0
Northern Ireland	Birkenhead-Belfast	9.5	2.0	2.0	2.0
Republic of Ireland	Holyhead-Dublin	3.5	2.0	2.0	2.0
Denmark	Harwich-Esbjerg	17.0	1.5	2.0	2.0
<u>Channel tunnel</u>					
France	Folkestone-Calais	0.6	0.25	2.0	2.0

Source: Agra CEAS assumptions based on discussions with ferry/Channel tunnel operators and the transport sector

- Based on discussions with hauliers and retailers of liquid milk, the volume of milk transported has been assumed to be 28,000 litres for bulk raw milk³² and 9,400 litres for fresh packaged processed liquid milk³³.

³² Based on the use of a standard 28,000 litre articulated milk tanker trailer.

³³ Based on the use of an articulated refrigerated ("reefer") trailer with a load capacity of 52 milk cages (i.e. 26 UK pallets), with each milk cage having an average load capacity of approximately 182 litres of milk.

- The *actual cost of the sea crossing* ranges depending on the mode of crossing and route, the operator and time of crossing. Table 4.2 presents a range of fares for crossing Britain's maritime border for individual routes, as well as an average return fare.

Table 4.2: Assumptions on monetary costs of crossing Britain's maritime border

Destination country	Ports/terminals	Single fare (one-way) (excluding VAT)	Average return fare (excluding VAT)
<u>Ferry</u>			
France	Dover-Calais	£150 - £193	£343
Netherlands	Hull-Rotterdam	£240 - £610	£850
Belgium	Hull-Zeebrugge	£240 - £572	£812
Northern Ireland	Birkenhead-Belfast	£240 - £532	£772
Republic of Ireland	Holyhead-Dublin	£352 - £384	£735
Denmark	Harwich-Esbjerg	£655 - £893	£1,547
<u>Channel tunnel</u>			
France	Folkestone-Calais	£210 - £286	£496

Note: Costs based on an articulated vehicle (12 metres long and 3 metres high) with a single passenger

Source: Agra CEAS assumptions based on discussions with ferry/Channel tunnel operators

Based on these assumptions, the cost of transporting liquid milk across Britain's maritime border to Belgium, Denmark, France, Ireland and the Netherlands is presented in Section 4.2.2 for raw milk and Section 4.2.3 for fresh processed milk.

All costs have been calculated assuming the vehicle (tractor unit and articulated trailer) is fully utilised 7 days a week, 365 days a year, for a single daily shift only (i.e. the vehicle is not used 24 hours a day). For each crossing, two costs are presented in Sections 4.2.2 and 4.2.3, representing the cost of transporting liquid milk across Britain's maritime with the articulated trailer returning empty (i.e. back empty) and with the articulated trailer returning fully loaded (i.e. back load), which allows some of the return journey costs to be passed on to that job. In the case of transporting bulk raw milk (Section 4.2.2), the cost of a CIP tank wash has been included.

4.2.2. Cost of transporting raw milk across Britain's maritime border

Figure 4.2 and Table 4.3 present the cost of transporting raw milk across Britain's maritime border to Belgium, Denmark, France, Ireland and the Netherlands from a distance of 45 miles either side of the port/terminal. As would be expected *a priori*, the cost of transporting raw milk across Britain's maritime border increases with distance, with transport costs ranging from 1.7ppl to France to 4.9ppl to Denmark. The cost of transport to Belgium, the Netherlands and Ireland was similar, ranging from 3.0ppl to 3.5ppl.

However, these costs assume that the articulated trailer is returning with a full load. If this were not the case, and the trailer were to return empty, then the cost of crossing Britain's maritime border would increase, ranging from 3.0ppl on the ferry and 3.2ppl through the Channel tunnel to France to

8.8ppl to Denmark. It is interesting to note that there is little difference in cost between using the ferry and transit though the Channel tunnel, despite the divergence in cost and journey time between the two routes.

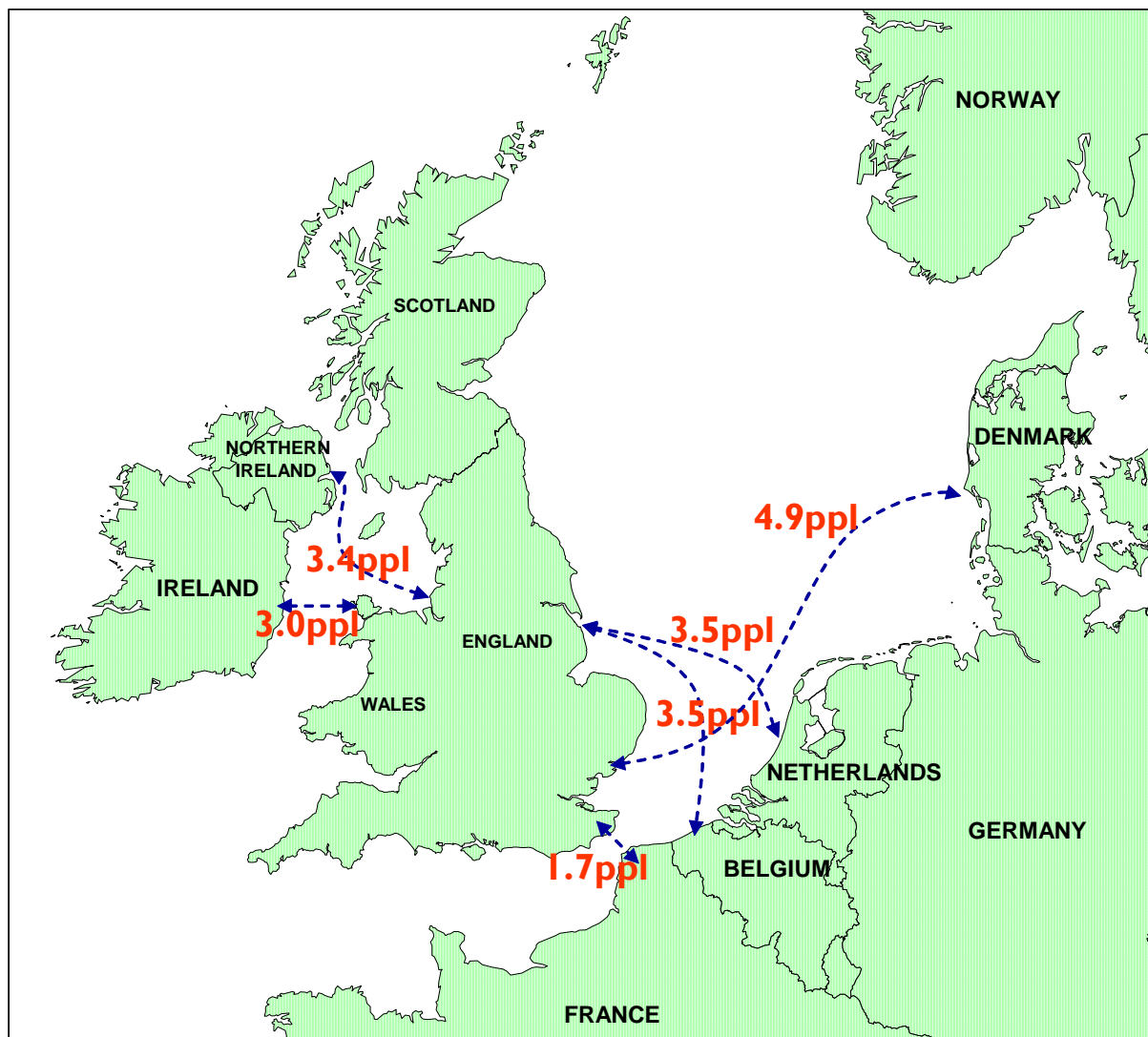


Figure 4.2: Cost of transporting raw milk across Britain's maritime border

Source: Agra CEAS calculations

Table 4.3: Cost of transporting raw milk across Britain's maritime border

Destination country	Ports/terminals	Cost (ppl)	
		Back empty	Back load
<u>Ferry</u>			
France	Dover-Calais	2.964	1.721
Netherlands	Hull-Rotterdam	6.029	3.525
Belgium	Hull-Zeebrugge	5.879	3.454
Northern Ireland	Birkenhead-Belfast	5.721	3.375
Republic of Ireland	Holyhead-Dublin	5.229	3.021
Denmark	Harwich-Esbjerg	8.768	4.896
<u>Channel tunnel</u>			
France	Folkestone-Calais	3.207	1.743

Agra CEAS calculations

4.2.3. Cost of transporting fresh processed packaged milk across Britain's maritime border

Figure 4.3 and Table 4.4 present the cost of transporting fresh processed milk across Britain's maritime border to neighbouring EU Member States from a distance of 45 miles either side of the port/terminal. As less packaged milk is transported in a refrigerated trailer compared with a bulk milk tank trailer, the cost of transporting packaged milk to Belgium, Denmark, France, Ireland and the Netherlands from a distance of 45 miles either side of the port/terminal is significantly greater. Transport costs range from 5.1ppl (8.8ppl back empty) to France to 14.5ppl (25.9ppl back empty) to Denmark.

Table 4.4: Cost of transporting fresh packaged milk across Britain's maritime border

Destination country	Ports/terminals	Cost (ppl)	
		Back empty	Back load
<u>Ferry</u>			
France	Dover-Calais	8.762	5.085
Netherlands	Hull-Rotterdam	17.830	10.429
Belgium	Hull-Zeebrugge	17.387	10.219
Northern Ireland	Birkenhead-Belfast	16.919	9.985
Republic of Ireland	Holyhead-Dublin	15.574	9.000
Denmark	Harwich-Esbjerg	25.934	14.485
<u>Channel tunnel</u>			
France	Folkestone-Calais	9.481	5.157

Agra CEAS calculations

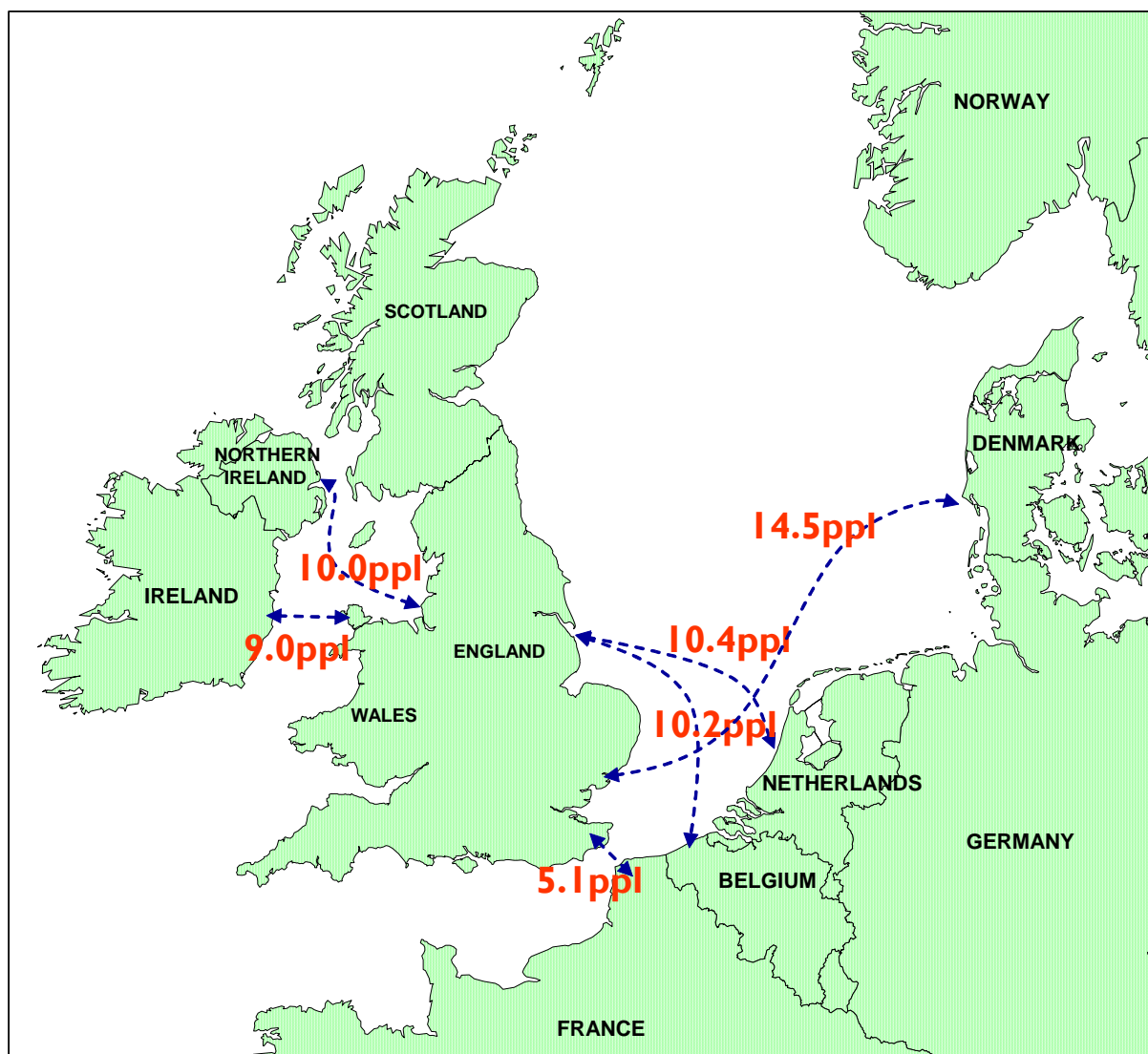


Figure 4.3: Cost of transporting fresh packaged milk across Britain's maritime border

Source: Agra CEAS calculations

4.3. Circumstances under which trade in liquid milk would be feasible

Since the formation of the Single European Market and implementation of common EC rules on milk hygiene, trade in liquid milk between Great Britain and other EU Member States has been minimal (Section 2). Little is known about the exact nature of this trade because trade statistics for Great Britain as a single trade block and for the different categories of liquid milk products are not available.

In general, trade in liquid milk is not considered by the industry to be viable at present. Both British based and European based liquid milk processors cite the primary reason to be the additional transport cost associated with crossing Britain's maritime border. However, for some products under certain conditions there is evidence of limited trade in both raw and processed milk with other European countries over the period.

Figure 4.4 portrays a matrix of GB-European trade possibilities for liquid milk, namely trade (both imports and exports) in raw bulk milk or processed liquid milk (which can further broken down into fresh (including filtered extended shelf life milks) and UHT forms). Within this matrix, examples of recent and current trade, for particular types of milk, are presented (based on interviews with the industry).

	Raw liquid milk	Processed liquid milk
Imports into Great Britain	<i>Organic milk</i>	<i>UHT milk</i>
Exports from Great Britain	<i>Milk for balancing</i>	<i>Filtered extended shelf life milks</i> <i>Branded UHT milk</i>

Figure 4.4: GB-European trade in liquid milk matrix

4.3.1. Potential for trade in raw milk

Economic theory suggests that should the price of identical products differ in two markets then, in the absence of transport and transaction costs, rents to arbitrage exist which ensure that traders move product from low price markets to high price markets until such rents are exhausted and the *law of one price* holds once more (Section 3.1). We would therefore expect, *a priori*, for raw milk trade to flow from Britain to neighbouring EU Member States, given that producer prices for raw milk are generally higher in other EU Member States, with the exception of Ireland (Figure 5.1, Section 5.3.3). However, it would appear likely that the *informal* barriers to trade identified in Section 3, and quantified to the extent possible in Section 4.2, form a significant impediment to moving milk across Britain's maritime border. In other words, transfer costs (i.e. transport and transaction costs) may be in excess of the producer price differential between these countries to allow trade.

Table 4.5 compares the producer prices paid by Arla Foods UK and First Milk with those paid by other European dairy companies. For those milk processing companies based in Belgium, Denmark, Ireland and the Netherlands, the reported price differentials are less than the cost of transporting raw milk across Britain's maritime border (as reported in Figure 4.2 and Table 4.3). This would suggest that arbitrage opportunities do not exist.

Table 4.5: Producer price comparison between British and European markets, 2005/06

Country	Company	Average price (ppl)	Price margin (ppl) compared with	
			Arla Foods UK	First Milk
Belgium	Belgomilk (Milcobel)	18.59	0.81	2.42
Germany	Humana Milch Union	17.99	0.21	1.81
	Nordmilch	18.19	0.42	2.02
Denmark	Arla Foods Denmark	18.37	0.59	2.20
Finland	Hameenlinnan.O.	21.37	3.60	5.20
France	Bongrain CLE	19.46	1.68	3.28
	Danone	19.66	1.89	3.49
	Lactalis	19.43	1.66	3.26
	Sodiaal	18.97	1.19	2.79
Great Britain	Arla Foods UK	17.78		1.60
	First Milk	16.18	-1.60	
Ireland	Glanbia	17.65	-0.13	1.48
	Golden Vale (South)	17.71	-0.07	1.53
Netherlands	Campina	17.86	0.08	1.68
	Friesland Coberco Dairy Foods	18.00	0.22	1.83
Sweden	Arla Foods Sweden	17.99	0.21	1.81

Note: VAT excluded, every other day collection, 350,000 kg per year, price per litre standard milk with 4.2% fat, 3.35% protein, SCC 24,999, TBC 24,999. All prices converted into £ Sterling at an exchange rate of £0.682:€

Source: Agra CEAS calculations based on LTO Nederland/EDF/Productschap Zuivel data

France is, however, an exception. The reported price differentials between all four French based processing companies and First Milk, and between just one French based processing company and Arla Foods UK, is greater than the cost of transporting raw milk across Britain's maritime border. That said, if a French dairy company wanted to purchase raw milk from a milk buyer such as First Milk, it would have to pay a premium price to reflect a profit element for this milk brokering service.

However, it should be noted that the cost of transporting raw milk across Britain's maritime border to France presented in Figure 4.2 and Table 4.3 only includes transit over a distance of 45 miles either side of the port/terminal; the additional cost of transport (from the dairy and to the final destination) on either side of the English Channel would also need to be calculated. Furthermore, transaction costs would also need to be calculated, which Fearn and Ray (1996) assume to be around 2ppl.

Naturally the producer milk price comparison presented in Table 4.5 will be sensitive to changes in exchange rate and movements in the milk prices paid by British milk processors relative to those paid by other European dairy companies. If the value of Sterling were to weaken against the Euro and/or the producer price differential paid by British milk processors *vis-à-vis* those paid by other European dairy companies were to widen, then the opportunities for trade would increase (i.e. the barriers to trade would fall).

Table 4.6 quantifies the impact of a weakening £ Sterling: Euro exchange rate (equivalent to an assessment of the impact of a reduction in producer milk prices paid in other European countries,

with those in Great Britain remaining unchanged). A 10% weakening in the £ Sterling: Euro exchange rate to £0.614:€ would, *ceteris paribus*, increase the producer price differential between British milk processors and other European dairy companies by 1.78ppl in the case of Arla Foods UK and 1.62ppl in the case of First Milk. At this exchange rate, the potential for trade (based on the transport costs presented in Figure 4.2 and Table 4.3 alone) would likely become more viable, particularly with France.

Table 4.6: Analysis of the impact of a weakening exchange rate on the producer price differential between British and European markets

Country	Company	£ Sterling: Euro exchange rate					
		£0.682		£0.614 (-10%)		£0.546 (-20%)	
		Arla Foods UK	First Milk	Arla Foods UK	First Milk	Arla Foods UK	First Milk
Belgium	Belgomilk (Milcobel)	0.81	2.42	2.59	4.03	4.37	5.65
Germany	Humana Milch Union Nordmilch	0.21	1.81	1.99	3.43	3.76	5.05
		0.42	2.02	2.19	3.64	3.97	5.25
Denmark	Arla Foods Denmark	0.59	2.20	2.37	3.81	4.15	5.43
Finland	Hameenlinnan.O.	3.60	5.20	5.37	6.82	7.15	8.43
France	Bongrain CLE	1.68	3.28	3.46	4.90	5.24	6.52
	Danone	1.89	3.49	3.66	5.11	5.44	6.72
	Lactalis	1.66	3.26	3.43	4.88	5.21	6.49
	Sodiaal	1.19	2.79	2.96	4.41	4.74	6.02
Ireland	Glanbia	-0.13	1.48	1.65	3.09	3.43	4.71
	Golden Vale (South)	-0.07	1.53	1.71	3.15	3.49	4.77
Netherlands	Campina	0.08	1.68	1.86	3.30	3.64	4.92
	Friesland Coberco	0.22	1.83	2.00	3.44	3.78	5.06
	Dairy Foods						
Sweden	Arla Foods Sweden	0.21	1.81	1.99	3.43	3.76	5.05

Source: Agra CEAS calculations based on data presented in Table 4.5

Exports from Great Britain of raw liquid milk - a balancing activity

That said, according to the industry raw milk has been exported in bulk out of the UK in recent years to countries such as the Netherlands. These exports have historically taken place as a *balancing activity* during periods of peak milk production when milk supply has been in excess of that demanded by the processing sector. It is understood that this trade in raw milk took place at marginal cost and the processing sector does not consider it to be a commercially viable option for the future. Moreover, in recent years milk processing companies have introduced new seasonality payment schemes to encourage a more even supply of milk to be produced throughout the year.

However, should milk quotas be abolished and raw milk production increase at a greater rate than investment in additional processing capacity, there may be a need to export this surplus raw milk in the future. This would likely be a short term balancing activity only until additional capacity becomes available.

The converse is true if British raw milk production were to fall. However, given the barriers to trade in liquid milk, it is unlikely that milk will be imported into Great Britain in raw liquid form for the production of (low value) commodity products, given the current economic conditions. According to MDC (2006), raw milk production in Great Britain would have to fall by around 1.5 to 3 billion litres to eliminate the production of commodity dairy products. This means that between 15% and 34% of British raw milk production could potentially be taken out of production (i.e. between 20% and 44% of British dairy farmers would need to leave the industry, assuming that production remains unchanged among remaining farmers (MDC, 2006)) before milk and dairy processors producing non-commodity products would need to consider the possibility of importing liquid milk (in raw or processed (liquid or product) form) for the domestic market.

Imports to Great Britain of raw liquid milk - the case of the organic sector

Organic raw milk is currently being imported in bulk, due to a national imbalance in supply and demand, during the autumn months from countries such as the Netherlands and Denmark. Raw organic milk imports into the UK during 2006/07 are estimated to have reached around 7 million litres, equivalent to 2% of UK raw organic milk production. In 2007/08, imports are expected to increase further to around 20 million litres, equivalent to 5% of domestic production. By 2008/09, sufficient additional domestic supply is expected to be available from organic producers currently in conversion (Table 4.7).

Table 4.7: UK raw organic milk balance sheet (million litres)

	2005/06	2006/07	2007/08	2008/09
Base UK supply	330	330	390	444
Planned expansion (%)		6%	6%	6%
Supply from existing producers	330	350	413	471
New entrants		40	31	85
Gross supply available	330	390	444	556
Utilisation (%)	90%	95%	96%	98%
Total utilisable UK supply	297	370	426	545
Imports		7	20	0
Total available supply	297	377	446	545
Total demand	312	375	443	543
Revised market surplus/(deficit)	-15	2	3	2

Source: OMSCo estimates

At the retailer level, a number of initiatives have been adopted to encourage increases in domestic production of organic milk (OMSCo, 2007):

- In October 2006, Tesco announced that for the next three years it is to pay the costs of organic inspection and technical support for OMSCo organic dairy farmers. This is seen as a practical means to demonstrate long term commitment to the sector, improve market stability and boost producer confidence.

- In March 2006, Sainsbury's launched its Farm Promise milk, with sales totalling 2 million litres per year. The milk, which is not organic, comes from in-conversion farms being supported by Sainsbury's to convert to organic production. For every pack sold, the farmer receives 5p more than the price paid for non-organic milk, which helps cover additional costs during the conversion process.

At the processing level, organic milk processors have increased the premium paid to producers for organic milk to encourage increases in domestic production. Currently, one British organic milk processor is paying a producer price premium of 10ppl for organic raw milk, compared to 0.4ppl in 2004.

However, OMSCO (2006) notes that the landed price of imported organic milk remains higher than UK domestic supply. Furthermore, organic liquid milk imports carry additional practical and operational problems which have to be addressed (OMSCo, 2006):

- practical implications such as packaging (labelling country of origin) changes and plant segregation are considerable and add significantly to cost;
- operational risks around availability, delivery windows and provenance; and,
- potential issues with quality and consistency resulting from long journeys and temperature integrity, which could translate into rejections or reduced shelf life.

Consequently, the organic sector believes that imports of raw organic milk have a role to play as a short term balancing activity only and in this respect imports are seen as a complement to, rather than a substitute for, domestic organic milk supply.

4.3.2. Potential for trade in processed liquid milk

As discussed in Section 3, liquid milk is a bulky, perishable and typically low value product, relative to the cost of transport. Moreover, in packaged form processed liquid milk requires more space in transport (than in bulk form), further adding to the per litre cost of transporting liquid milk. Thus, to offset the relatively high transport costs of crossing Britain's maritime border into other European countries, markets in which consumers are prepared to pay a premium price for liquid milk will have to be found and targeted and/or the supply chain will have to accept lower profit margins. Profit margins on liquid milk have remained relatively stable for the milk processing sector over time, have generally fallen at farm level, whereas the retailers' liquid milk margin has steadily increased (Figure 4.5).

Looking specifically at the potential for imports of processed liquid milk into Great Britain, a number of significant barriers to trade (as discussed in Section 3), in addition to the cost of transport, will likely inhibit the extent of such potential trade. However, the middle ground seems to be the most likely market segment to face competition from imported milk given that these customers tend to impose less demanding quality and service standards, compared to multiple retailer segment, and are

arguably less concerned about provenance. In addition, access to milk depots does not seem to provide any impediment to imports. The middle ground is currently a growing market segment, accounting for around a quarter of all liquid milk sales (Table 3.3). However, the cost of crossing Britain's maritime border and the scale efficiencies of UK liquid milk processing capacity provide a considerable barrier to entry to this market segment.

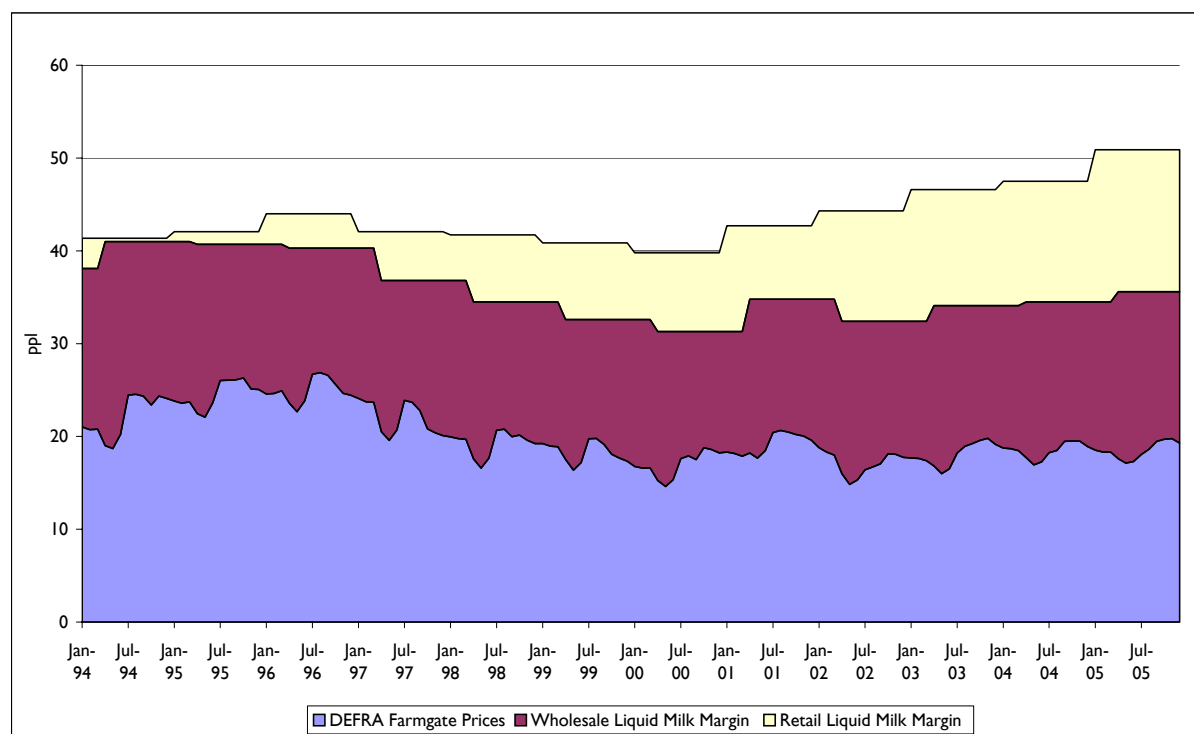


Figure 4.5: UK liquid milk margins

Source: MDC datum

Imports to Great Britain of processed liquid milk - UHT competition on the home market

As discussed in Section 3.3.2, UHT milk is regularly imported into Great Britain from neighbouring EU Member States, including France, Germany and Belgium. Most of this imported UHT milk is supplied to the discount retail sector (as well as some middle ground customers). According to the industry, there is unlikely to be any significant change in sales of UHT milk through this distribution channel/market outlet and British demand for UHT milk is expected to remain virtually unchanged in the medium term.

Thus, the stringent supplier requirements imposed by the multiple retail sector have effectively limited the potential to increase UHT milk imports further, despite the operational cost disadvantages of British UHT milk processors. That said, the relative competitiveness of UHT milk imports *vis-à-vis* domestic production is highly sensitive to exchange rate movements (Section 3.3.2). Developments in exchange rate will likely have a significant impact on the future evolution of trade in

UHT milk, given that price is generally the criteria which determines choice of procurement for the discount retail sector (as well as some middle ground customers).

Exports from Great Britain of processed liquid milk - geographical scope of branded UHT

Despite relatively substantial imports of UHT milk by the discount retail sector (as well as some middle ground customers), Britain has also been exporting UHT milk. In 2004, Milk Link secured distribution in Malta with a leading importer, and began exporting *Scottish Pride* long life milk and long life *Moo* milk. Milk Link is the second largest supplier of long life milk to Malta, with a 25% share of the market. In addition, Milk Link supplies long-life milk to Spain and the Canary Islands.

Milk Link is targeting the growing British ex-pat community and tourist sector (Figure 4.6) within these European countries with its range of long life milks (and associated dairy products). In particular, there has been strong growth in the number of British people visiting Spain (Figure 4.7). According to Milk Link, the success of its expanding export trade is due to the increasing importance that consumers place on provenance in their purchasing decisions (Section 3.4.3).

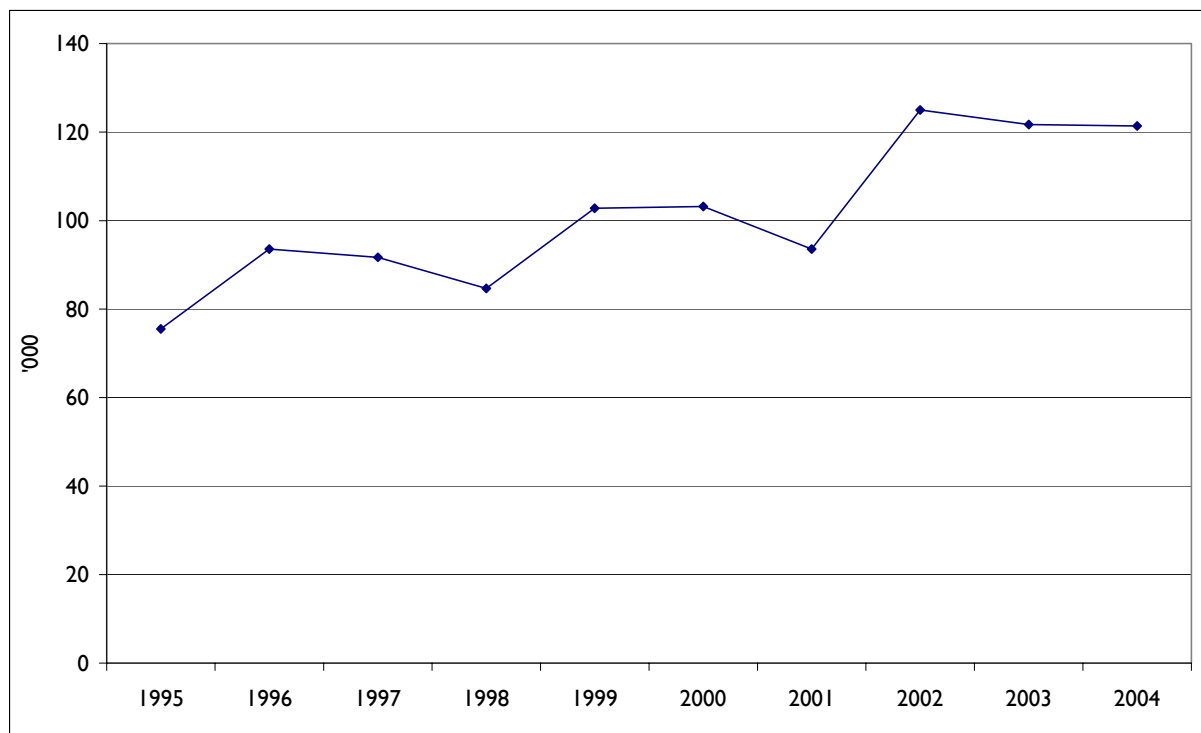


Figure 4.6: Outflow of the British population to EU countries

Source: ONS

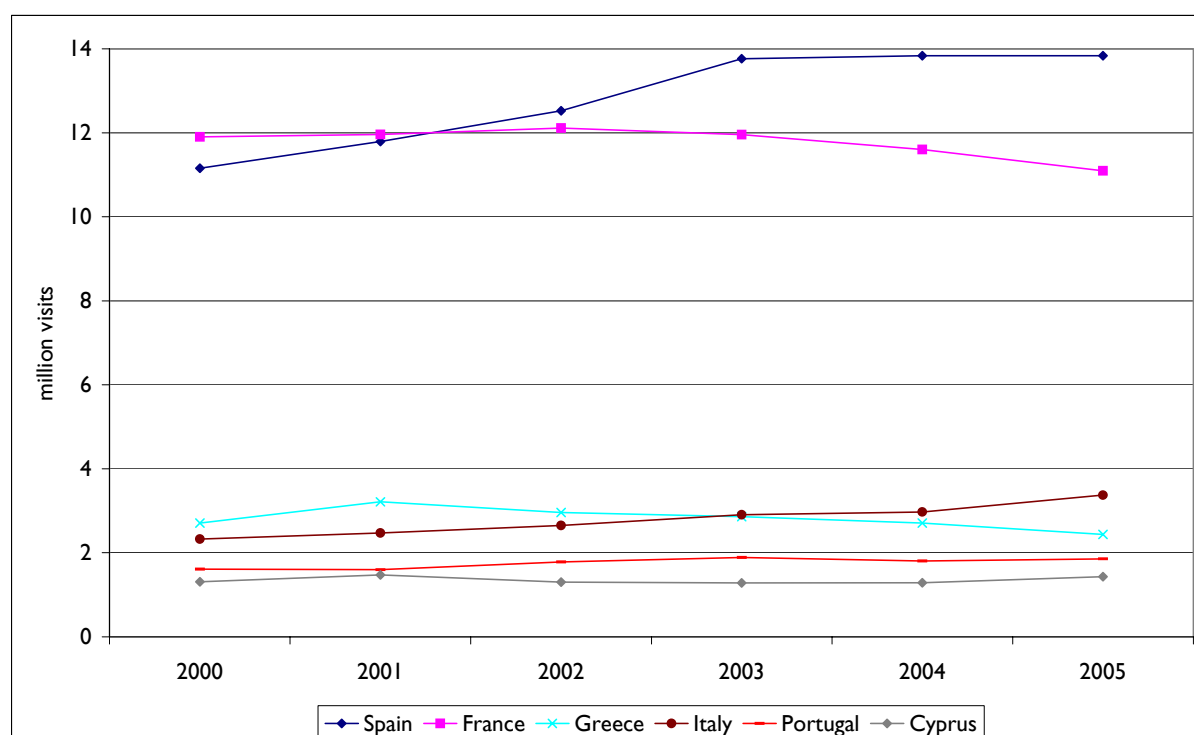


Figure 4.7: Number of British visits to southern EU countries

Source: ONS

Exports from Great Britain of processed liquid milk - geographical scope of filtered ESL milks

The recent development in filtered extended shelf life fresh milks was discussed in Section 3.4.2, where it was noted that both Arla Foods UK's *Cravendale* and Wiseman Dairies' *Puriti* brands are currently being exported in packaged form to Spain. Similarly, the target market for these extended shelf life milks is the British ex-pat community and tourist sector, where there is a high demand for fresh processed milk which traditionally has not been met.

Importantly, the development in micro filtration technology now allows *fresh* milk to be exported from Great Britain to European markets by virtue of its extended shelf life of 20 days, which is double that of conventional fresh pasteurised liquid milk. In addition, the premium price consumers are prepared to pay for 'fresh' milk in these European markets (relatively inelastic demand) and efficiency savings in distribution makes trade viable.

These distribution efficiencies include the use of a specialist foodservice company to transport the filtered extended life milks to Spain and the Canary Islands and distribute it to individual retail outlets. This allows loads of multiple food products to be combined in distribution, thereby making the export and distribution of relatively smaller quantities of liquid milk viable. Neither company makes any change to its packaging or labelling.

Although filtered extended shelf life fresh milks are considered to be a niche sector at present, sales continue to trend upward and further marketing and promotional campaigns are planned for 2007 onwards in both the British and European markets. The potential to increase the market share of British (filtered extended shelf life) fresh liquid milk in some European markets seems favourable given that little domestic competition currently appears to exist for *fresh* milk. Furthermore, the size of the British ex-pat community and the British tourism sector in Europe, where latent demand for such liquid milk exists, has been showing a steady increase over time (Figure 4.6 and Figure 4.7).

However, the extent to which British exports will satisfy this growing demand for fresh pasteurised liquid milk will depend on the *nature* and *scale* of this demand in the medium to long-term. In terms of *scale*, as demand increases there will likely come an economic point where it will become viable to establish fresh milk processing capacity in these export markets to supply this demand, thereby benefiting from lower transport costs. The extent to which British export demand will then remain sustainable will depend on the *nature* of demand, which would be reflected in the extent to which provenance (demand for British milk) and British milk processors' brands form a barrier to trade in these markets.

4.4. Conclusion

This Section has discussed a number of likely circumstances under which trade in liquid milk between Great Britain and other EU Member States is likely to be feasible. Given that liquid milk is a bulky and typically low value product, the cost of transporting liquid milk across Britain's maritime border to neighbouring EU Member States, and typically its perishable nature, forms a significant barrier to trade.

For trade to be viable, the difference between the price of liquid milk in two markets has to be greater than the transfer costs (i.e. transportation and transaction costs), which are a product of the *informal* barriers to trade. As would be expected *a priori*, the cost of transporting fresh processed milk to neighbouring EU Member States increases with distance. The cost of transporting raw liquid milk across Britain's maritime border (from a distance of 45 miles either side of the port/terminal) with France was found to be around half the cost of trade with Belgium, Ireland and Germany, and around a third of the cost with Denmark.

Nevertheless, for some products under certain conditions there is evidence of limited trade in both raw and processed milk between Great Britain and other European Member States. Historically, raw milk exports have occurred as a short term balancing activity at marginal cost. For processed liquid milk, the medium to long term potential for trade seems relatively more sustainable. In particular, the development in micro filtration technology now allows *fresh* milk to be exported from Great Britain to European markets by virtue of its extended shelf life of 20 days. If this growing trade remains sustainable, then it may have significant implications for the definition of the fresh liquid milk market as applied by competition authorities when assessing horizontal mergers within the industry. According to Fingleton (2006), the competition authorities currently have no evidence to believe that

imports and exports of raw milk and fresh liquid milk into and out of Great Britain take place in significant volumes.

That said, when considering the effect of a merger in the UK, the Office of Fair Trading has responded to our findings by suggesting that the issue of imports into Great Britain may be more relevant than the issue of exports from Great Britain. The Office of Fair Trading notes³⁴ that *"if fresh milk is imported in significant volumes over a sustained period of time, and if import volumes are not constrained, then it may be possible to conclude that the market for fresh milk comprises Great Britain as well as the country or countries from which the imports originate. However, such a conclusion would also need to be supported by evidence demonstrating that customers consider such imports to be credible substitutes for domestic suppliers, and that domestic suppliers have regard to imports when setting their prices"*. This would suggest that the definition of the fresh liquid milk market, as applied by competition authorities when assessing horizontal mergers within the industry, is likely to remain as national at its widest, at least in the short to medium term. Our findings suggest that although there is evidence that fresh milk is being imported into Great Britain, volumes remain limited and the increasing importance placed on provenance would tend to limit the degree to which imports form credible substitutes.

³⁴ Following the presentation of the draft final report on 4th May 2007

5. Market integration in the European liquid milk market

5.1. Introduction

Economists often view a close association between prices of similar goods in spatially or vertically separated markets, a concept closely associated with the *law of one price* (as described in Section 3.1), as being a sign of competition and the efficient functioning of markets. However, it should be noted from the outset that closely related prices might also reflect oligopolistic, collusive or price fixing behaviour or other potentially distorting public policy measures.

This Section considers the extent to which potential competition from continental suppliers constrains the pricing behaviour of British liquid milk processors, by assessing the degree to which the UK liquid milk market can be considered as a separate entity from those of its trading partners. This assessment is carried out using Bayesian econometric time series analysis of price transmission between producer prices for raw milk in the UK and five neighbouring EU Member States, which actively traded liquid milk with the UK during the period January 2000 to November 2006. Conclusions concerning the degree to which the British raw milk market can be considered isolated from the raw milk market of neighbouring EU Member States have clear implications for the regulation of markets, market institutions and for competition policy. If it is true that this trade is conducted by arbitrators (as described in Section 3.1 and in discussed in more detail in Section 5.2) with the result that some form of price stabilisation occurs along the lines postulated by the *law of one price*, then it may be inappropriate to consider one market in isolation from its trade partners when considering appropriate regulation.

An extensive literature has been developed on evaluating spatial market integration to assess the degree to which price shocks in one market are transmitted into spatially separate markets. The interest for the economist is often, as noted by Barrett and Li (2002), concerned with the concept of *pareto efficiency*³⁵, since prices form the appropriate signalling mechanism of the relative scarcity of a particular product which ensures that producers specialise appropriately and that resources are optimally used in the production of that product. The notion of price transmission also has important implications for the *pareto* efficient allocation of resources, with the pass-through of policy and non-policy changes determining the extent to which different individuals gain or lose.

This Section is structured into the following sub-sections. Section 5.2 presents a detailed conceptual overview of the *law of one price* and the concepts of *pareto efficiency* and arbitrage as well as a critique of the various approaches available to assess market integration within the context of this research. In Section 5.3, the empirical methodology used in this research to assess the degree to which the UK liquid milk market can be considered as a separate entity from those of its trading partners is presented, with an outline of the novel Bayesian approach to time series analysis (Section 5.3.1) and

³⁵ A *pareto* efficient allocation is the allocation of resources in which no one individual can be made better off without making someone worse off (Nicholson, 2005).

the range of linear and non-linear price analysis models, including Threshold Error Correction Models (TECMs), which can be used to account for transport and transactions costs in international trade are introduced (Section 5.3.2). Data issues and an explanation of the producer price time series used are presented in Section 5.3.3. The results of this econometric analysis are presented in Section 5.4, detailing the results for each of the price analysis models employed (Sections 5.4.1) and the parameter estimates for the *preferred* price analysis model (Section 5.4.2). Finally, conclusions on the extent to which potential competition from continental suppliers constrains the pricing behaviour of British liquid milk processors in Section 5.5.

5.2. Conceptual overview

The *law of one price* states that the price of identical goods in spatially separated markets should be the same after conversion to a common currency. The mechanism by which the *law of one price* is maintained is that of *spatial arbitrage*. Should the prices of identical products differ in two markets then, in the absence of transport and transaction costs, rents to arbitrage exist which ensure that traders move product from surplus, low price, markets toward deficit, high price, markets until such rents are exhausted and the *law of one price* holds once more.

The issues of integration and efficiency, in the context of spatially separated markets, has attracted much attention in the literature and are often linked to concerns over the impact of market liberalisation across developed, less developed and transition country economies alike (Baulch, 1997). Early work in this area used cross market price correlation or simple regression-based tests to assess the degree of market integration. More recently the recognition that price series are often non-stationary has led to widespread use of cointegration techniques following Ardeni (1989).

However, these relatively simple Granger causality and cointegration approaches to the problem have been criticised on the grounds that they ignore the potentially important role played by transfer costs, such as transport and transactions costs (McNew and Fackler, 1997; Fackler and Goodwin, 2001; Barrett, 2001; and Barrett and Li, 2002), they assume a linear relationship between prices which is inconsistent with discontinuous trade (Baulch, 1997), and possess only weak power to discriminate between integrated and independent markets.

The transmission of price signals between spatially segregated markets may, if it occurs, exhibit a non-linear form, not least due to the presence of transport and transaction costs. Price co-movement might, under these arbitrage conditions, be 'equilibrium restoring' when price differentials exceed transfer costs to traders while when the price differentials fall short of transfer costs, prices are not equilibrium restoring. This case could lead to a switch in regime between periods of trade and non-trade. However, if some proportion of traders' transfer costs are fixed then it is possible that some form of, somewhat slower, equilibrium restoring process may still be expected within the 'threshold', or 'neutral', band around equilibrium. The insight that there may be bands and asymmetries in price adjustment means there is a need for new approaches.

The most common 'new' approach used in the recent literature makes use of threshold effects, as one manifestation of poor transmission, to take account of transport and transactions costs, asymmetries and non-linearities (e.g. Abdulai, 2000). One strand of the threshold literature has focused on asymmetric adjustment, whereby prices might adjust differently depending on whether they are above or below equilibrium (see for example: Granger and Lee, 1989; Kinnucan and Forker, 1987; and Mohanty *et al.*, 1996). Threshold behaviour and asymmetric adjustment are distinct concepts. However, Abdulai (2000) also distinguishes between threshold models of an asymmetric and a symmetric type, the former being where the reaction to positive price shocks differs from that to a negative shock, but both types allow for asymmetric within and out of threshold adjustment.

It is the latter case that is of interest to this analysis. Under such circumstances, and within a range, markets may be effectively separated, in that trade does not occur, although still integrated according to the modified *law of one price* definition. Only when prices are outside of a threshold, will price changes in one market be transmitted to another market. This type of threshold model corresponds closely to those introduced by Balke and Fomby (1997) and developed by Hansen and Seo (2002) and Seo (2003)³⁶. Goodwin and Piggot (2001), and Sephton (2003) make use of similar models to these in the context of price transmission.

The approach to testing the degree of market integration used in much previous work follows this tradition. It rests upon testing the time series property of price and trade data in order to establish whether dependent and independent variables are cointegrated. If cointegration can be established then firstly, there will exist Granger Causality between the variables and secondly, we can assume that there exists a long-run equilibrium relationship between those variables. In the absence of cointegration, little can be said about a long-run relationship. However, there may still be evidence of causality in which case it may be possible to establish how short-run shocks to one market affect a second market, although this form of shock transmission does not imply the form of market integration needed when considering a wider market for policy purposes.

This approach to assessing the degree to which spatially separated markets can be considered as integrated is not without its critics (see for example: Balcombe and Morrison, 2002), but to the degree that empirical work can investigate market integration, the framework represents one tractable approach. However, this classical pre-testing approach to time series analysis of price transmission is not ideal when one wishes to consider thresholds or other non-linear models for a number of empirical reasons. *For this reason, a novel Bayesian approach to econometric time series analysis will be employed to assess the degree to which the UK liquid milk market can be considered as a separate entity from those of its trading partners.*

³⁶ These articles postulate that the existence of transaction costs prevents investors realising an investment opportunity and apply threshold cointegration to the term structure of interest rates.

5.3. Methodology

5.3.1. Bayesian econometric time series analysis

The use of *Bayesian Econometric time series analysis* as a methodology³⁷ differs significantly from the *Classical Econometric time series analysis* used in much of the empirical literature in this area. The shift in paradigm toward Bayesian methods has a number of advantages:

- Firstly, we move away from the potential path dependency implicit in the ‘general to specific’ or ‘testing down’ process.
- Secondly, Bayesian methods accommodate the treatment of complex non-nested model selection problems that can circumvent the need for pre-testing for series properties.
- Thirdly, a Bayesian framework permits the use of prior information to ensure that key model parameters conform to theoretical requirements and facilitate hypothesis testing of these, and other model restrictions, which can tell us much about the properties of economic variables and relationships.

In applying this approach we are able to explore non linearities employing a *Bayesian Monte Carlo Markov Chain* (MCMC) approach to estimation and inference. Although Bayesian methods have been applied in the context of cointegrated threshold models in the past (see for example: Balcombe, 2006; Balcombe *et al.*, in press), applications are still few and there are a number of extensions that have yet to be investigated.

Furthermore, the Bayesian approach adopted here permits the comparison of linear error correction models with threshold error correction models by means of the marginal likelihood function to enable model choice. In addition, model selection tests permit lag length selection, tests for weak exogeneity and the selection of rank restrictions that characterise the behaviour of the variables as stationary, stochastically trending and/or cointegrated.

5.3.2. Price transmission analysis

The analysis of price transmission between spatially separated markets relies upon the identification a long-run relationship between prices in each market. A long-run equilibrium relationship can be estimated between two time series as a standard regression model:

$$y_{t_i} = \alpha + \beta x_{t_i} + u_{t_i} \quad (1)$$

³⁷ At present, the models and approach applied here are the subject of a manuscript under review. That draft, and in particular the econometric content of that draft, has received a set of favourable responses from three independent referees in the first round of the peer review process in a major Agricultural Economics journal.

Where both y_t and x_t are non-stationary (stochastic trend or $I(1)$) variables describing prices in spatially separated markets a and b , respectively, in the log form. The parameters α and β require estimation and μ is a disturbance term that may be serially correlated.

Under these conditions, the parameter β can be interpreted as a long-run 'elasticity of price transmission'. This elasticity describes the magnitude of adjustment of the price, y_t , to variations of the price x_t . Under complete price transmission, the parameter β should equal -1. However, partial, or incomplete, price transmission would be indicated by $\beta > -1$ since changes in the price x_t are not fully passed onto the individual price y_t . Therefore, we can interpret estimated β values of greater than -unity as indicative of uncompetitive behaviour on the part of agents, the impact of policy measures which segregate markets or other barriers to trade between markets a and b . Importantly, an estimated β from Equation (1), which relates transmission into market a , can be used to calculate the transmission elasticity into market b as $1/\beta$.

A Vector Auto Regression model (VAR) or Error Correction Model (ECM) with maximum lags limited to 1 month, so that the dependent and independent variables might appear up to once lagged forms in the estimating equation.

As an alternative to pre-testing for time series properties of order of integration, cointegration and Granger Causality prior to estimation, here we simply estimate a full set of competing non-nested models and use model selection procedures to select the best representation of the data generating process. The models estimated include:

- Model 1: Linear, cointegrating model with cointegrating vector (β) via an ECM;
- Model 2: Linear, cointegrating model allowing for weak exogeneity of the independent price (x);
- Model 3: Linear, cointegrating model allowing for weak exogeneity of the dependent price (y)
- Model 4: A non-linear, Eq-TAR model, with differential within and out of threshold adjustment parameters;
- Model 5: A non-linear, Band-TAR model, with zero within threshold adjustment parameter;
- Model 6: A Stationary model with no rank restriction using a VAR;
- Model 7: Fully difference model using a VAR.

Each of the above 7 models represents different, and near exhaustive, theoretical interpretations on the properties of the data generating process for each pair of prices. Following estimation of each model, model performance can be assessed and a best performing model selected. The implications of selecting models 1 to 7 are as follows:

- **Model 1:** This model suggests that there is both cointegration and causality between the price pairs and that a cointegrating β , or transmission elasticity, between x and y can be identified.
- **Model 2:** This model allows for weak exogeneity of x on y and suggests that there is "long run non-causality". As such, the long-run price of x is not determined by price y .
- **Model 3:** This model allows for weak exogeneity of y on x and suggests that there is "long run non-causality". As such, the long-run price of y is not determined by price x .
- **Model 4:** This model suggests that there is a long-run relationship or equilibrium between x and y but that there are thresholds about an equilibrium between x and y where attraction back to equilibrium has differential speeds of adjustment dependent on whether deviations from equilibrium lie outside or within a threshold. Thresholds are often associated with transport and transaction costs.
- **Model 5:** This model suggests again that there is a long-run relationship or equilibrium between x and y and again that there are thresholds about an equilibrium between x and y . However, here attraction is back towards the threshold limit rather than to the equilibrium. Adjustment within the threshold band is considered to be zero. Band-TAR thresholds are often associated with transport and transaction costs that prohibit trade within close proximity to equilibrium.
- **Model 6:** This model suggests that prices are mean reverting. While there may be a cointegrating relationship, only short-run transmission is feasible.
- **Model 7:** This model suggests that there is no cointegrating relationship, and therefore no association between x and y , their markets cannot be considered integrated.

Each of these models is estimated in parallel using four simultaneous estimating algorithms and convergence of the algorithms is tested³⁸. For each model, the logged maximum marginal likelihood is recorded. This statistic can be used to select between competing non-nested models in order to identify the assumptions and data properties that best characterise the data generating process.

5.3.3. Data collection and issues

To assess the degree to which the UK liquid milk market can be considered as a separate entity from those of its trading partners, we consider the analysis of market integration and price transmission (using a set of 5 price pairs) between the UK and Denmark, France, Ireland, the Netherlands and Germany, all of which are key trading partners (Section 2.4).

The price data used in this analysis was collected from the European Commission (DG Agri) and consisted of monthly time series of national average prices received by farmers for raw milk (actual fat content) in the UK, France, Denmark, Germany, the Netherlands and the Republic of Ireland for the period January 1990 to November 2006. These prices were denominated in nominal Euro per 100kg and had already been converted into this common currency. All price series were

³⁸ With four algorithms, each sampling 1,000 times, post burn-in each model takes approximately 12 minutes to run for each price pair..

subsequently converted into real price form using appropriate retail price index (RPI) deflators obtained from Eurostat.

An initial examination and analysis of the time series price data suggested that at least one structural break existed in the UK price series during the 1990s. Since this period coincided with the process of deregulation and the period during which Milk Marque was found to have been able to exploit its monopoly position by using its selling system to price discriminate and to control the supply of milk made available to the market (Competition Commission, 1999), it was considered that this may have contributed to this structural break in the data. Furthermore, preliminary Classical cointegration analysis on this longer set of price series suggested that most of the prices in question were mean reverting (stationary) and appeared to rule out the existence of any long-run equilibrium relationship between markets.

Therefore, the price data covering the period January 1990 to December 1999 was omitted from further analysis. Figure 5.1 presents the producer raw milk price series (in real terms) used in the analysis.

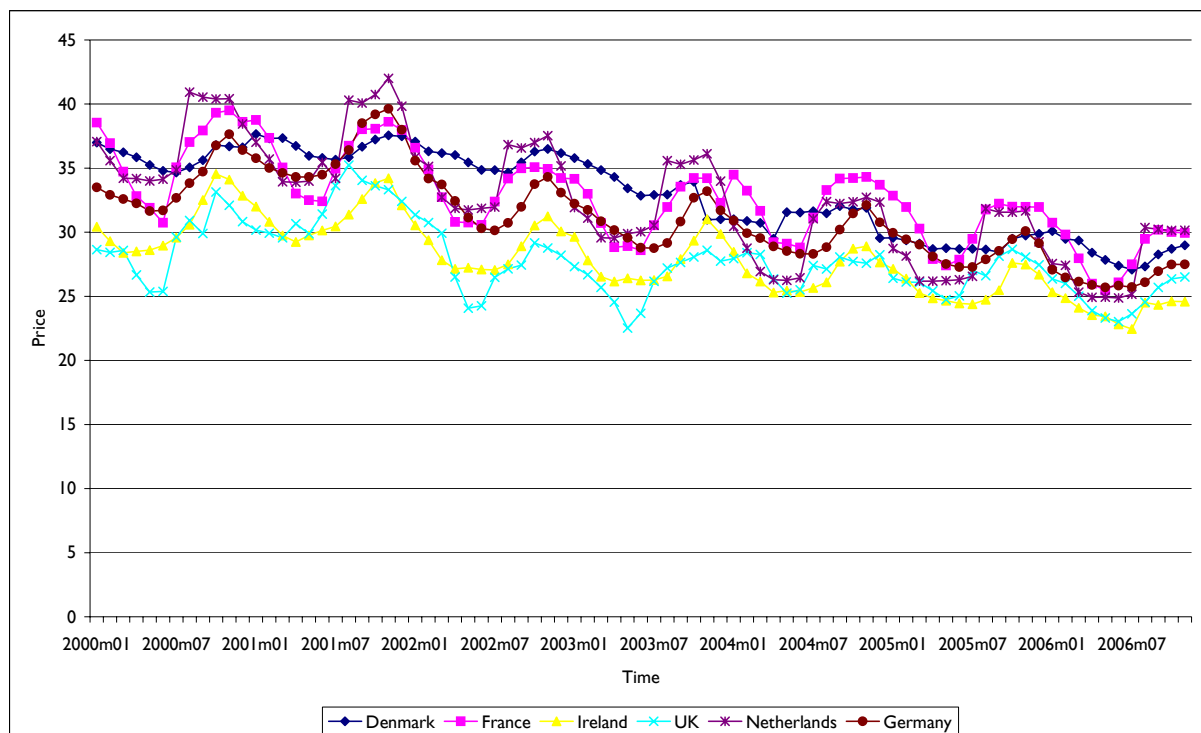


Figure 5.1: Raw milk producer price series (in real terms), Euro per 100kg

Source: European Commission

5.4. Results

5.4.1. Model and series property selection results

Table 5.1 presents the logged maximum marginal likelihood values recorded for each of the seven competing models for each of the five price pairs. It should be noted that these statistics are comparable only between competing models for each price pair in isolation and provide only a relative measure of model performance.

Table 5.1: Model selection logged maximum marginal likelihood

Y=UK	Model 1 Linear, Adj=1	Model 2 Weak Exog of x	Model 3 Weak Exog of y	Model 4 Eq-TAR	Model 5 Band-TAR	Model 6 Stationary	Model 7 Differenced
X=							
Denmark	234.31*	233.07	234.13	226.95	231.13	215.77	232.63
France	242.65	243.76*	241.60	237.71	240.39	225.29	241.47
Ireland	240.24	241.02*	239.44	236.71	239.22	224.78	239.40
Netherlands	217.88*	217.42	217.86	212.64	215.77	202.27	216.09
Germany	258.59*	258.12	256.52	252.49	254.99	238.90	256.77.

* Marks the 'preferred' model for each price pair.

The selection criteria chose two fairly simple models as representative of the data generation processes for the five price pairs tested here. In all cases, the preferred model maintains the assumption that the price pairs are cointegrated. This finding is further supported by observing that the maximum marginal likelihood for Model 6, the stationary model, indicates that this model performs most poorly across the board and that the differenced model, Model 7, under-performs all of the non threshold cointegrating models, namely Models 1, 2 and 3.

The models which perform best according to the nature of the data and chosen to assess market integration between the UK and each EU Member State in this analysis are depicted in bold in Table 5.1:

- For the UK/Denmark, UK/Netherlands and UK/Germany, Model 1, the cointegrated model with a long-run equilibrium, performed best.
- For the UK/France and UK/Ireland, Model 2 performed best, indicating that these price pairs are cointegrated, but that long-run price shocks are only transmitted in the direction of the UK market. In this respect, the results fail to find any long-run influence of UK prices on either French or Irish prices, even though short-run shocks may be transmitted in that direction.

Surprisingly, neither threshold model (i.e. Models 4 and 5) out performed either Models 1, 2, 3 or 7. Empirically, since allowing for threshold behaviour would be expected to improve the probability of identifying market integration, and the *law of one price* behaviour, it is surprising to find that both

threshold models significantly under-perform the simpler representations. This suggests, from a policy point of view, that:

- transport and transaction costs could be very small (which seem at odds with the findings presented in Sections 3 and 4 given that milk is a bulky, perishable and typically low value product, relative to the cost of crossing Britain's maritime border);
- transport and transaction costs are consistently larger than the price margins (i.e. the difference in prices between the UK and other EU Member States) in this data set (this would *a priori* seem plausible given that the differences in producer prices between Member States tend to be lower than the relative cost of trading liquid milk across Britain's maritime border (Section 4)); or,
- that contractual and institutional relationships effectively remove transactions costs (which cannot be ruled out in this research).

5.4.2. Model parameter estimates

The results from the analysis of market integration and price transmission between the UK and Denmark, France, Ireland, the Netherlands and Germany using the preferred (chosen) models for each trading EU Member State (Section 5.4.1) are presented in Table 5.2. These results report the Bayesian estimates for the mean and median values of the posterior distributions of β , the long-run cointegrating parameters describing the elasticity of price transmission between the price in market x and the UK and between the UK and market x .

Table 5.2: Long-run transmission and short-run adjustment speed for the preferred model specifications

Cointegrating Model, Bayes Estimates of Cointegrating Vectors/Long-run Elasticities and S/R Adjustment Speed							
$Y=UK$ $X=$		Beta mean	median	stdv	ecm (-1) mean	medium	stdv
Denmark	DK=BetaUK	-0.745	-0.758	0.588	0.072	0.071	0.038
	UK=BetaDK	-1.343	-1.319		-0.094	-0.085	0.060
Netherlands	NL=BetaUK	-1.447	-1.395	0.615	0.103	0.101	0.054
	UK=BetaNL	-0.691	-0.717		-0.125	-0.121	0.063
Germany	GE=BetaUK	-1.101	-1.109	0.356	0.082	0.077	0.049
	UK=BetaGE	-0.908	-0.902		-0.172	-0.166	0.094
Weak Exogeneity of x Bayes Estimates of Cointegrating Vectors/Long-run Elasticities and S/R Adjustment Speed							
		Beta mean	median	stdv	ecm(-1)	medium	stdv
France	FR=BetaUK	-1.194	-1.196	0.480			
	UK=BetaFR	-0.837	-0.836		-0.214	-0.210	0.083
Ireland	IR=BetaUK	-1.291	-1.293	0.449			
	UK=BetaIR	-0.775	-0.774		-0.242	-0.240	0.091

Market integration between the UK and Denmark, the Netherlands and Germany

The upper part of Table 5.2 presents evidence of long-run equilibrium relationships between the UK raw milk market and the markets in the Denmark, the Netherlands and Germany. Specifically, two

sets of Beta's are reported, the first describes price transmission from the UK into market x (i.e. Denmark, the Netherlands and Germany) and the second describes price transmission towards the UK. Since the primary objective of this analysis is to consider the extent to which potential competition from continental suppliers constrains the pricing behaviour of British liquid milk processors, this analysis concentrates on the latter.

Looking first at the price transmission between the UK and Denmark, the value of the price transmission elasticity (i.e. the beta mean, presented in column three of Table 5.2), from Denmark into the UK (-1.343) suggests that the long-run UK producer price for raw milk 'over responds' to shocks from the Danish market.

In the case of the Netherlands and Germany, the transmission of price signals into the UK market appear to be less than perfect, but important. The evidence suggests that long-run producer price changes in the Dutch market appear to be passed through to the long-run producer price in the UK by nearly 70% and from Germany by just over 90%.

The mean and median values of the posterior distributions of the coefficient of the Error Correction term (ECM) in the estimating equations are presented in columns 6 and 7 of Table 5.2. The value of these terms report the speed at which short-run price shocks in one market are transmitted into the second market. In the case of the price pairs, UK/Denmark, UK/Netherlands and UK/Germany, relatively slow short-run adjustment speed is reported, ranging from 0.07 from Denmark to the UK, to -0.17 from the UK to Germany.

Market integration between the UK and France and Ireland (Eire)

The lower part of Table 5.2 presents evidence of long-run equilibrium relationships between the UK raw milk market and the markets in France and Ireland (Eire), and specifically the estimated mean and median values of the posterior distributions of Beta and the ECM term for the two price pairs, for which Model 2 is preferred. Both parameters have the same interpretation as above, but within these cases additional attention is needed in interpretation since the estimating model used (i.e. Model 2) has different assumptions to Model 1.

The most important consideration is that the estimates derived from the preferred Model 2, imply weak exogeneity of price x , which in this case are the trade partner prices for Ireland and France. In choosing this model for the UK/France and UK/Ireland producer price pairs, evidence has been found to support the contention that prices in the UK have no long-run causal effect on either French or Irish raw milk producer prices. However, a one-way causal relationship was found for both the UK/Irish and UK/France price pairs. Therefore, only the Beta's describing price transmission from market x (i.e. France and Ireland) into the UK are meaningful. In this respect, Table 5.2 presents price transmission elasticities from both France and Ireland of -0.837 and -0.775, respectively, suggesting near complete price transmission. Furthermore, the transmission of short-run price shocks from both France and Ireland appear to spread at a much faster rate into the UK market than

was found in the case of the other three EU Member States, with short-run adjustment speeds reported of -0.214 from France to the UK, to -0.242 from Ireland to the UK.

5.5. Conclusion

Market integration - impact of trade in liquid milk

Perhaps the most surprising methodological finding from the analysis presented above is that the non-linear threshold specifications performed so poorly relative to the simpler linear models. As such, we have been unable to detect any impact of transport and transaction costs on the *law of one price* mechanism as it holds across the paired markets. However, this failure to find threshold behaviour is likely caused by the fact that most of the European producer price series for raw milk considered lie consistently above those of the UK throughout the period by a relatively constant margin. (Evidence presented in Section 4.2 would suggest that transport and transaction costs are generally in excess of this relatively constant price margin.) Therefore, it appears that, for much of the period studied, just one price adjustment 'regime' or speed is consistent with arbitrage behaviour.

Market integration - long run transmission of prices

The results reported from the preferred (chosen) models suggest that the UK raw milk market is relatively well integrated with those five EU Member States (trade partners) considered in this analysis. The *Bayesian Monte Carlo Markov Chain* approach used in this analysis to assess market integration and price transmission produces results which suggest that each of the five EU Member States (partner markets) considered have influenced prices in the UK (British) raw milk market over the period 2000 to 2006 through the transmission of long-run price signals. This suggests a wider degree of market integration than might have been expected *a priori*.

Specifically, the results suggest that for the UK/Denmark, UK/Netherlands and UK/Germany price pairs, evidence of a long-run equilibrium, in both directions, between spatially separated market prices was found. Furthermore, the Bayesian model selection procedure supports the contention that both French and Irish prices influence UK liquid milk prices in the long-run, but that no long-run causality flows in the opposite direction. It would appear, therefore, that the UK does not have a long-run causal influence on either French or Irish prices.

The extent to which actual or potential trade in liquid milk is responsible for this market integration is difficult to quantify given the aforementioned trade data limitations³⁹. However, as noted in Section 3.1, there are several marketing channels by which prices can be equalised between markets, thereby establishing a chain of inter-related prices for the same (commodity) product at different geographic locations and at different stages in the marketing chain⁴⁰ for raw, processed and commodity products.

³⁹ A detailed breakdown of liquid milk trade data by product type (raw milk, processed conventional milk, processed organic milk and UHT milk) and at the Great Britain level was not available.

⁴⁰ Each price is related to the next by the cost of transporting, transforming and marketing the product.

One possible explanation for this unidirectional transmission of prices from both France and Ireland to the UK is the relative increased importance that the highly tradable commodity markets play in setting milk prices in these countries. It is well documented that commodity products (such as butter, powder and certain cheeses) set the floor price to the market, and the homogenous nature of most liquid milk means that average producer milk prices are driven by price movements in commodity markets (see for example: Dairy UK, 2006; MDC, 2006). In France and Ireland, the feed through from these commodity markets may be faster given that a producer price index system operates in France (directly tracking movements in butter, milk powder and whey) and that the vast majority of Irish dairy production is in the form of commodity products.

Market integration - short run transmission of prices

The model results reported in Table 5.2 also suggest that, where long-run bi-directional causality is supported, short-run transmission of price shocks appears relatively subdued, although in the French and Irish markets short-run price shocks were transmitted much faster.

These milk markets are geographically closer to the UK market than those of Denmark, Netherlands and Germany. Accordingly, economic theory (Section 3.1) suggests that price equalisation (the *law of one price*) is more likely to take place in such markets due to relatively lower transport and transaction costs and the resultant increased opportunities for arbitrage. In Section 4.2, the cost of transporting raw liquid milk across Britain's maritime border with France was found to be around half the cost of trade with Belgium and Germany, and around a third of the cost of trade with Denmark. Trade between Northern Ireland and Ireland does not incur the additional costs of crossing a maritime border.

Implications for competition policy

These results therefore suggest that in terms of competition there is significant evidence that the UK (and British) liquid milk market cannot be treated as an isolated and insulated market, although each competition inquiry will review the issues on their own merits. There is clear statistical evidence that the UK (British) raw milk market is relatively well integrated with other EU Member States, despite the fact that there is relatively little trade in liquid milk.

Beyond the 'difficult' theoretical question of what price transmission really means and the empirical question of whether such a relationship exists or can be measured lies the problem of whether we should expect trade in liquid milk in the EU to be driven by prices and market mechanisms in managed, output constrained, markets.

It would appear that any search for an explanation of trade patterns in liquid milk should be directed toward policy and the structure of markets. Here, milk quotas play a large part in that they govern overall milk availability i.e. surplus available for processing above and beyond domestic market requirements. On the supply side the case of Ireland's 'excess' quota allocation is a case in point. On the demand side however, if we can assume that the milk processing industries operate under increasing returns to scale (suggesting imperfect competition in any case) then, given a binding

domestic supply constraint, importing even relatively expensive supplies from high price regions can be advantageous to an individual processor on the domestic wholesale and retail markets. It may be that these factors have had a bearing on the relatively poor performance of the threshold specifications.

Finally, we should recall that we can only interpret the *law of one price* in terms of trade in a homogeneous commodity. Any deviation in the qualities embodied in that product across markets will violate our analysis. There is much evidence to suggest that a significant proportion of the imports of liquid milk into the UK are of specific qualities for niche markets, including organic milk but the question remains as to the differences in the aggregate quality of product at the level of each country.

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